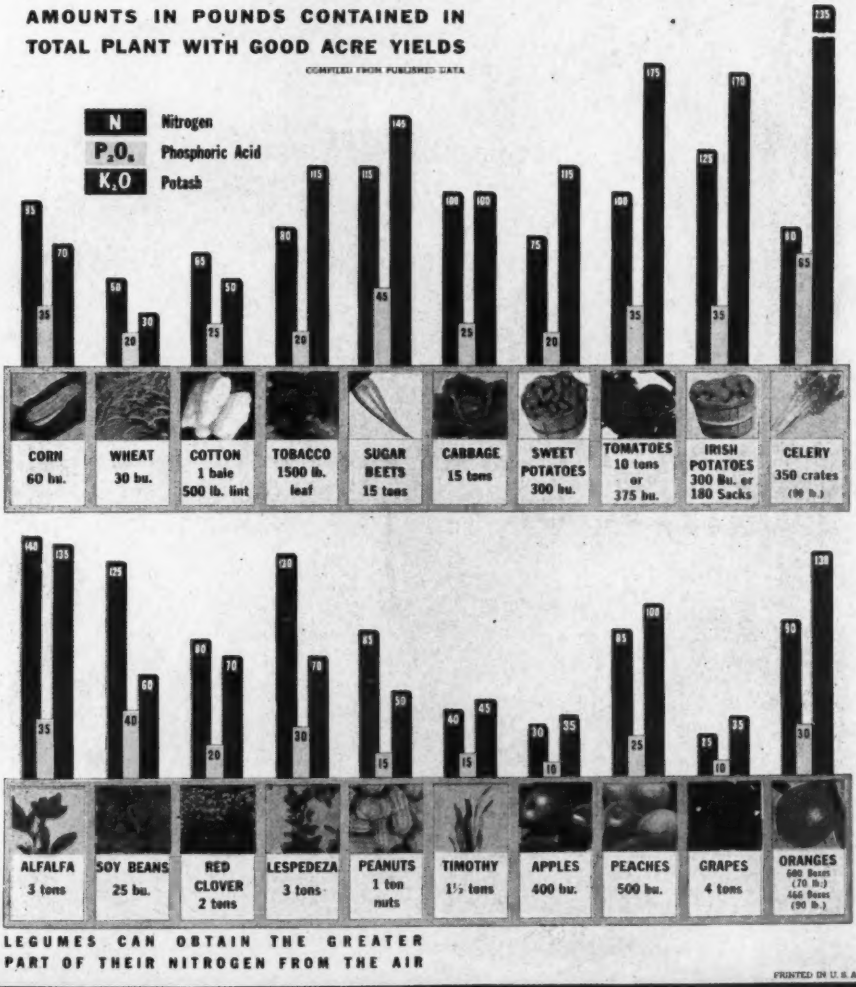
Better Crops with PLANT FOOD

PLANT-FOOD UTILIZATION


AMOUNTS IN POUNDS CONTAINED IN TOTAL PLANT WITH GOOD ACRE YIELDS
COMPILED FROM PUBLISHED DATA
N Nitrogen
P_2O_5 Phosphoric Acid
K_2O Potash
CORN 60 bu.
WHEAT 30 bu.
COTTON 1 bale 500 lb. lint
TOBACCO 1500 lb. leaf
SUGAR BEETS 15 tons
CABBAGE 15 tons
SWEET POTATOES 300 bu.
TOMATOES 10 tons or 375 bu.
IRISH POTATOES 300 Bu. or 180 Sacks
CELERY 350 crates (90 lb.)
ALFALFA 3 tons
SOY BEANS 25 bu.
RED CLOVER 2 tons
LESPEDEZA 3 tons
PEANUTS 1 ton nuts
TIMOTHY 1½ tons
APPLES 400 bu.
PEACHES 500 bu.
GRAPES 4 tons
ORANGES 600 Boxes (70 lb.) 466 Boxes (90 lb.)
LEGUMES CAN OBTAIN THE GREATER PART OF THEIR NITROGEN FROM THE AIR

PRINTED IN U. S. A.

APRIL 1940 - - - - - - - - 10 CENTS

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AMERICAN POTASH INSTITUTE, INC.
INVESTMENT BUILDING **WASHINGTON, D. C.**

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

J. D. ROMAINE, *Chief Agronomist*

Editorial Office: Investment Bldg., Washington, D. C.

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American Potash Institute, Inc.

Investment Building, Washington, D. C.

J. W. TURRENTINE, *President and Treasurer*

O, TO BE A BOY AGAIN, AND SHINNY UP A TREE!

Better Crops with PLANT FOOD

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VOL. XXIV WASHINGTON, D. C., APRIL 1940 No. 4

A rural journalist goes to Washington

MSS. in D. C.

Jeff McDermid

NOW it can be told. How a group of rural journalists came to the District of Columbia seven years ago this April and fraternized for the launching of the AAA with plenty of MSS. For the unsophisticated let me explain that this refers to the writing of manuscripts to spread the gospel of the new agricultural adjustment period; and lest anybody anticipate political bias herein, I hasten to say that journalists always write on one side of the paper, but on either side of the subject with equal facility.

When Art of Iowa and I signed the employment sheet, we became the first and genuine original staff members of the AAA. In fact, we arrived a couple of weeks ahead of Uncle George Peek, and they gave us weighty volumes of congressional hearings to digest so we would be prepared to issue the first releases (hand-outs) as soon as the new farm act got by the Senate. Nobody knew what the title of the farm act was to be, but I can tell you exactly who typed the first official statement for the press that carried the final name of the new organization, the Agricultural Adjustment Administration.

It was wiry, red-haired Vernon Bundy, loaned to our group by Milt Eisenhower of the press service of the Department of Agriculture. We had been fussing around over strange and unfamiliar terminology related to crop control and processing taxes, ignorant of what the big shots had dubbed the thing. Vernon rushed in grinning, having covered a confab downstairs in Marse Henry Wallace's sanctum where the infant law had been christened with

Midwest holy water, figuratively thickened with Dixie dewdrops. He slapped a few sheets of flimsy into the machine and sailed in, remarking over his cigarette stub that the historic moment had arrived for rural America.

Vernon wasn't so far wrong either, since what was then a bottomless emergency has become a chronic condition in our farm affairs. Regardless of your feelings one way or the other, the AAA has had almost as big an effect on national agriculture as the invention of the steel plow and the cotton-gin, but in what manner I leave gentle and opinionated readers to suit themselves inserting. My quarrel is not with economists or reformers or candidates, but with red tape, pressure groups, and Washington weather. So you won't get one iota of satisfaction arguing with me over details, as this stuff will be too vague and wandering to merit rebuttal.

WELL, anyway, Art and I looked up from our littered mahogany desks, anxious and alert to start flinging rush copy at the bewildered heads of callous correspondents for the UP, the AP, and so on. It was great dope for us rubes to be able to befuddle a Washington newspaper hound with new tricks, so we put in some fresh ribbons and waited. But our wish was never gratified. We were not tough enough to get their goats. In fact, we soon had saddle gall, they rode us so hard.

Although we had been there but five weeks, we were weary of waiting. For on many hot nights we had thrown ourselves on lumpy beds in the ten hundred block on Sixteenth Street, grubbing over fine print in those old government reports. Our chief solace was that we were quartered only three blocks from the White House, ready and willing to be called if the President needed someone of experience to help him stabilize or demonetize or allot something. Since then I have wondered if he ever got word we were so close and handy.

I doubt if Justice Taney on the eve of the Dred Scott decision, Mr. Lincoln before the emancipation proclamation, or Mr. McKinley when they sank the *Maine,* had any greater sense of deep responsibility than Art and I up there on that third floor front beneath the shadow of a tulip tree. That is, we sensed we were on the fringes of Something Important, events that moved as ponderously and irrevocably as the epochs we had conned as kids in the district school histories. Art was young and fresh and ambitious, while I was middle-aged but eager as an old firehorse to answer the alarm.

I recall that we studied late and pondered deeply over owlish theories of agricultural salvation. We were hack horsemen for the brain trust. Although we had no license to tip off the chiefs to their errors, we mentioned them in private to each other between cooling sips from soft-drink bottles. Later on, after several sustained sieges with the reporters, we *may* have had draughts of something a *trifle* harder, but it never got us pixilated. We always saw Things As They Ought To Be, which is more than I can say for some of the rugged individualists who raised minority moans to Let Things Alone.

SOMETIMES our mental outlooks got so foggy from much humidity and legal sentences that we put on our clothes after midnight and sailed forth to stalk the silent streets, where almost every corner reeked with tradition, legend, and portentous history. Up Sixteenth Street to U Street, west a block to New Hampshire Avenue, southeast five blocks to Dupont Circle, back to the right again on Connecticut, clear out to Eighteenth and Columbia Road, east again to Sixteenth along Euclid, down past the churches and the imposing embassies, and home to roost —tired enough of legging it to "bed down" and let somebody else shuffle the New Deal deck.

On Sundays we postponed the Problem again. We put on our mattress-pressed suits and hiked to Arlington

to call on General Lee or over to Capitol Hill to see the Hall of Horrors. One of us toted a brownie camera, and we took turns posing and snapping each other in front of Big Generals on Iron Steeds or even nonchalantly leaning against the White House portico, like unto one who Goes Into Conference. These prints made great fillers

to enclose in letters of little consequence. Folks would know we had been Called to the Front for Something. It gave you heaps of inner satisfaction after mailing them to vision how the kids and maybe Mother herself would really take them seriously and even show them to that bullheaded neighbor who voted the wrong ticket.

WE HAD our childish moments though, such as gathering violets along the west bank of the Potomac near the highway proving grounds and collecting specimens of more trees than we ever heard of in Rock Creek Park. It's lucky we picked those nature pieces before we got hog-tied in red tape and fettered with futility. Later on we were content to sit with the mussy doves in McPherson Square and watch the old ladies take their cats out for air and so forth. Oh, yes, I think we went to church once, because it was too rainy to ramble.

Finally by June the newly calked and somewhat unwieldy craft was pushed off the ways into the sea of uncertainty with a splash that dampened the first pages of many newspapers. It was commanded by Admirals Peek and Brand, with Boatswains Chet Davis and Hugh Westervelt ruling production and marketing cargoes respectively, and the consumer's counsel down in the cook's galley manned by Fred Howe, the reformer. Oh, yes, we had Rexford Tugwell aboard also, but he stayed aloft most of the time looking for pirates, reporting likewise the direction of the wind to Jerome Frank, whose duties were to keep us clear of legal shoals. The rest of us handled the pitch and tar and did the holystoning on the brass-bound deck. The voyage was financed by processing taxes. But you shall hear no briny tales of Fiji or Bali, because we never left the Potomac tidewater.

WITHIN the confines of the chart room we journalists reveled in the comradeship of congenial souls, each having distinct duties assigned as Conductors of Public Relations for certain cargoes and commodities. Art of Iowa got corn and hogs, a longshanks from Kentucky dealt softly and persuasively with cotton and tobacco, a forthright native son of Dakota prairies tackled wheat information, a squat Connecticut reporter chased elusive marketing agreements, I drew the dairy enigma, and a restless Michigan scribe strewed copy all around. Our boss was Alfred Stedman, before and since the reporter for a newspaper bearing a deceptive title redolent of backwoods journalism, the *Saint Paul Pioneer Press*.

Whenever I think of that exciting voyage my memory turns to a rhyme in one of Mark Twain's yarns concerning A Storm on the Erie Canal, and how the desperate crew avoided scuttling the ship by tossing out many odds and ends, including at last "the handsaw and the sow." But ere our officers began to discover stowaways and introduce them to the sharks, I was too busy repelling boarders with my keen shafts of logic to bother much about barnacles and mutinies.

For six months or so the whole kit and caboodle of us release writers pro-

(*Turn to page* 47)

Potash Helps Cotton Resist Wilt, Rust, and Drought

By P. A. Young

Plant Pathologist, Agricultural Experiment Station, College Station, Texas

FUSARIUM WILT and potash hunger (sometimes called rust) cause large annual damage to cotton on sandy soils of east Texas. Wilt alone kills 5 to 50 per cent of the cotton in many fields each year. As profits from cotton usually depend on large yields per acre, it is important for farmers to use fertilizers and varieties of cotton that are likely to produce large yields. Much work, which has shown that potash applications help to control cotton wilt and rust, has already been done in the southern States. Even where wilt and rust are not severe, previous work by the Agronomy Division of the Texas Agricultural Experiment Station has shown that increased yields of cotton may be obtained from the use of certain fertilizers.

Fusarium wilt is caused by a fungus that lives in the soil, enters cotton roots, and grows through the upper parts of the plants. This wilt parasite causes browning of large areas in the cotton leaves, blackening of the groups of water tubes in the leaf petioles, falling of the leaves, and blackening and browning of the woody part of the stems. Until the plant dies, the bark on the stems and roots remains normal in appearance. Wilt-diseased plants usually die early and produce only a few or perhaps not any bolls. A similar disease is caused by a fungus named Verticillium, but this Verticillium wilt was not concerned in the experiments described here.

Symptoms of potash hunger (rust) include yellowing and browning between the leaf veins often followed by large black spots caused by a fungus named Alternaria. In plants with severe symptoms of potash hunger, most of the leaves fall early and the plants are badly dwarfed, producing only poor yields of cotton.

Fig. 1.—Coker 100 cotton showing severe symptoms of potash deficiency and 35% of the plants with Fusarium wilt in row on left; 6-8-0 fertilizer. In contrast, the wilt-resistant Cook 307 cotton, aided by 6-8-8 fertilizer in the row on the right, was nearly normal.

The Texas Agricultural Experiment Station in cooperation with the U. S. Depart-

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ment of Agriculture has conducted regional cotton variety wilt studies at Jacksonville, Texas, for the last 3 years to determine the effects of potash fertilizers and wilt-resistant varieties of cotton on wilt and rust in relation to the yields of cotton. Two fields of Norfolk fine sandy loam soil (separated only by a road) were selected for the experiments because 25 to 50 per cent of the cotton in these fields had Fusarium wilt and most of the plants showed symptoms of potash deficiency in the years before the experiments were started. For the experiments, 12 varieties of cotton were planted each year in 108 rows 100 ft. long. Each variety was treated in nine places with 6-8-0, 6-8-4, and 6-8-8 fertilizer, the varieties and fertilizer treatments being randomized. In 1937, 400 lb. of fertilizer per acre were used. The experiments were moved across the road to a field with more nearly uniform soil, and fertilizers were used at the rate of 600 lb. per acre in 1938 and 1939. Cotton was planted late in April and thinned to 240 plants per row in June.

Symptoms Appeared Early

The rows of experimental cotton looked nearly alike in May and June. However, early in July when the hot, dry weather occurred, the rows of cotton without potash fertilizer developed severe symptoms of potash deficiency. Estimates of percentages of plants with potash deficiency are given in Table 1. The plants apparently were starving from lack of potash and were badly damaged by drought. In the rows without potash, most of the plants shed most of their leaves in July and August, and nearly all of the plants were severely dwarfed. In contrast, the rows that received 24, 32, and 48 lb. of potash per acre usually showed little or no symptoms of potash deficiency, and nearly all of the plants grew large and kept most of their leaves until November. In most cases symptoms of potash deficiency were prevented (Figures 1, 2, 3).

Fig. 2.—Severe symptoms of potash deficiency in Cook 144-68 cotton with 6-8-0 fertilizer in row on right. Nearly normal Dixie 14-5-2 cotton aided by 6-8-8 fertilizer in row on left.

Data summarized for 3 years in Table 1 show large increases in cotton yields due to the use of potash fertilizers. The wilt-susceptible varieties, Coker 100 and Half and Half, showed an average increase of 38 per cent (range of 35 to 42 per cent) in pounds of seed cotton per acre with 4 per cent potash fertilizer, and an average increase of 58 per cent (range of 52 to 63 per cent) in pounds of seed cotton per acre with 8 per cent potash fertilizer. The 7 wilt-resistant varieties of cotton showed an average increase of 28 per cent (range of 20 to 39 per cent) in pounds of seed cotton per acre with 4 per cent potash fertilizer, and an average increase of 37 per cent (range of 28 to 51 per cent) in pounds of seed cotton per acre with 8 per cent potash fertilizer. The increases in yields naturally were usually smallest in 1937 when only 400 lb. of fertilizer per acre were used and about one-fifth of the cotton was on soil not seriously deficient in potash. Increasing the potash from 0 to 4 per cent in the fertilizer gave the largest increases in yields, but very profitable additional increases in yields

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British Columbia Uses Boron for Fruit

By H. R. McLarty, Ph. D.

Dominion Laboratory of Plant Pathology, Summerland, British Columbia, Canada

DIRECTLY north of the famous Wenatchee apple district of the State of Washington is located one of the major fruit-growing areas of the Dominion of Canada, the Okanagan Valley of the Province of British Columbia. The climate is semi-arid with long, sunny days in the summer and usually mild winters. The annual precipitation averages approximately 12 inches, and irrigation is generally practised. The fruits grown are principally apples, peaches, plums, prunes, and apricots.

In common with other fruit-growing areas, this district has its complement of plant diseases. In this semi-arid climate, however, fungous diseases are of relatively minor importance and their place has been taken by so-called physiological disorders. Chief among these have been those which are now known to be due to a deficiency of boron. It is not definitely known when boron deficiency disorders first appeared, but they caused little, if any, commercial loss previous to 1921. From 1921 to 1935 they continually increased in severity and became of such economic importance as to seriously threaten the future of fruit culture throughout the entire district. A description of these disorders and some information on the measures being taken to control them should therefore be of interest.

Boron deficiency in a fruit tree may manifest itself by a number of widely divergent symptoms. These, because their common cause was at first unknown, were classified as separate diseases and were given descriptive names. On apple there are five such diseases recognized in British Columbia, corky

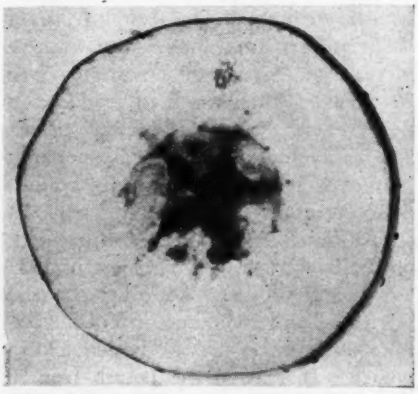

Fig. 1.—Corky core on Jonathan.

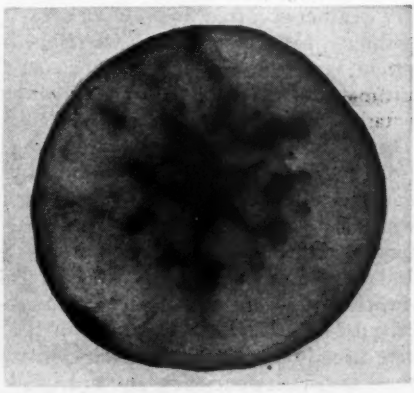

Fig. 2.—Corky core on McIntosh.

Contribution No. 611. Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa, Canada.

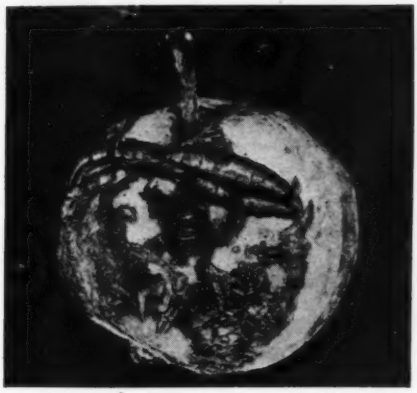

Fig. 3.—Drought spot on McIntosh.

core, drought spot, flat fruit, measles, and die back; on pear and cherry, drought spot and die back; on peach, plum, and prune, die back.

Apple: *Corky Core.* This descriptive name is applied to a condition which becomes evident in the fruit during its later stages of development. The name was suggested by Dr. C. C. Shearer of the U. S. Department of Agriculture on the occasion of a visit to the district in 1923. It has also been called core rot and internal cork. The condition is characterized by the occurrence of islands of yellowish brown tissue in or near the core. The amount of tissue involved varies from a single spot not more than one-eighth of an inch in diameter to a considerable proportion of the flesh in and around the core.

The trouble first appears about the time the fruit is half grown and may continue to appear until it is picked. After picking no further development takes place. From the outside, affected fruit appears normal, and the trouble can be detected only when it is cut. Jonathan and McIntosh are the two varieties most susceptible, while Delicious is rarely affected. In Jonathan the islands usually occur within the core (Fig. 1), in McIntosh (Fig. 2) in the flesh adjacent to the core.

Drought Spot. The term drought spot is somewhat misleading as a descriptive name, for the disorder is by no means always associated with drought. It designates a condition that affects the fruit during its early stages of development. The first appearance of the disorder may occur about 10 days after the petals have fallen, and the trouble may continue to develop until the apple is an inch or more in diameter. The areas affected are chiefly confined to the external tissues of the calyx end, but may involve almost any portion of the flesh.

The first observable symptom is water-soaked spots of dead tissue which develop in the phloem of young twigs. Cutting these open discloses the dead tissue underneath. The cambium is not affected. As the growth of the twig continues, the epidermis is broken, and a measles effect is produced. On the Delicious, which is a very susceptible variety, the affected tissue usually lies immediately beneath the epidermis, is only a few cells thick, and spreads out over a considerable area, occasionally being as much as several inches long by one-half inch or more wide. The epidermis over the affected area dies, turns brown, and can be readily peeled off.

Die Back. Boron deficiency may cause a dying back of limbs and twigs. The first symptom one notices is that buds on apparently healthy twigs fail to develop in the spring, though at that

Fig. 4.—Drought spot on Jonathan.

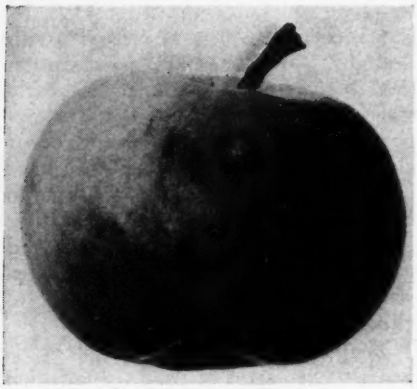

Fig. 5.—Flat fruit on Spitzenburg.

time no injury is apparent in them or in adjacent bark tissue. The buds usually affected are those on the previous season's terminal growth, but in some cases there may be practically no development. Occasionally small leaflets or flower clusters are produced, but these soon wilt and fall. As the season advances the affected buds and adjacent bark tissue die, leaving the characteristic dead twig ends projecting beyond the foliage, which gives to the disorder its name (Fig. 8). This trouble is not associated with severe winter temperatures, though commonly it has been confused with winter injury.

Other Tree Fruits. The boron deficiency disorders of other tree fruits have not been as varied or as extensive as those on the apple. All except apricot, however, have shown some condition of the affected tissue which is soon followed by death and a turning to dark brown. As with corky core, however, the symptoms vary on different varieties. On McIntosh (Fig. 3) and some others, the injury is usually limited to the epidermal tissue where it spreads over the surface in an irregular manner causing blotches. As the fruit matures, the injury appears as a russetting somewhat similar to that caused by frost or an injurious spray. When the attack is severe, the growth of the fruit is checked, and large cracks develop on the surface. On other varieties (Fig. 4) the injury occurs as dark brown spots which may vary from one-eighth to one-half inch or more in size. They usually extend from the surface inward, but may be entirely beneath the epidermis. As such fruit develops, it is much misshapen and bumpy.

Flat Fruit. No dying of tissue occurs with this disorder, but the apple loses its characteristic shape, becoming much shortened from the calyx to stem end. The Delicious (Fig. 6), for example, loses its typical long shape, and the bumps on the calyx end may disappear almost entirely; the Newtown and the Spitzenburg (Fig. 5) may become so flattened as to be scarcely recognizable.

Measles. This disease has been attributed by different workers to various causes, but it too is now generally recognized as being due to a boron deficiency. It gets its name from the eruptions or blisters produced on the bark (Fig. 7). Small pimples are the first noticeable symptoms on most varieties, and these originate around characteristic symptoms. On pear and cherry there occurs a drought spot. On pear it is characterized by the presence of an excess number of stone cells in the calyx end of the fruit and the appearance of large surface cracks midway between the calyx and stem ends about the time the fruit is half grown (Fig. 9). On the cherry it produces a dying and shrivel-

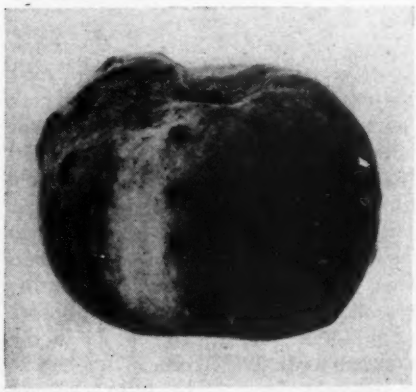

Fig. 6.—Flat fruit and drought spot on Delicious.

Fig. 7.—Measles on apple twigs.

ling of epidermal tissue around the blossom-end 2 to 3 weeks after the petals have fallen. Die back occurs on pear, cherry, peach, plum, and prune (Fig. 10), and the symptoms are similar to those on apple.

Contributing Factors. The factors which determine the kind or kinds of disorder with which a tree will be affected are as yet little understood. On the apple, each of the five disorders have occurred on all varieties grown in the district, and all may be present at the same time on an individual tree. More commonly, however, a tree will be affected with only one or two disorders and not have any symptoms of the others. Frequently only one limb on a tree will be affected or even one apple of two or more on an individual fruit spur. Some varieties are more susceptible than others to one or more, but no one variety shows the highest susceptibility to all.

Weather conditions and cultural practices have a marked influence on the occurrence and severity of attack. Periods of drought due to lack of rainfall or improper irrigation are frequently associated with an outbreak. Excessive use of nitrogenous fertilizers and over-irrigation on heavy land sufficient to cause water logging are likewise contributing factors.

Control. Effective control of the various disorders described has been accomplished with boron compounds. Three methods of application have been used, injection, spraying, and soil application. In the injection method, the boron compounds were placed in holes bored into the trunks of the trees. This method was discarded because of the labor involved and the danger of causing severe injury to the bark around the points of injection.

The spraying method has been tested experimentally but has not been used to any extent commercially. Sprays were applied to trees in both the dormant and summer seasons, and complete control was obtained in all cases. A one per cent boric acid solution was found to be the most satisfactory of the concentrations tested. This was safe on apple foliage but in a few cases caused slight marginal burn on pear. This method proved to be particularly advantageous when an immediate response was required, but it was more troublesome and expensive to apply

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Fig. 8.—Die back on apple twigs.

Tobacco Production Benefits by Research

Louis H. Wilson

Editor, North Carolina Department of Agriculture, Raleigh, North Carolina

NORTH CAROLINA now boasts the largest tobacco research station in the Nation. Strangely, but wisely, a handful of pioneering agricultural leaders 27 years ago selected Granville County's Poor Farm upon which to conduct research on the State's No. 1 cash crop, tobacco, a crop that last year brought Tar Heel growers in excess of $115,000,000.

Today the Oxford Tobacco Experiment Station, located one mile southwest of Oxford, North Carolina, is composed of a 250-acre battleground where State and Federal agronomists and other research specialists wage war upon nutritional problems, tobacco pests, and diseases that have taken millions of dollars from the pocketbooks of the farmers.

The program of the test farm has been so widespread and far-reaching that it is not uncommon to find five or six representatives of foreign governments at the station at one time. During one day recently, experts from England, Australia, China, Persia, India, and Argentine were directed to the farm by the U. S. Department of Agriculture for information. But the real worth and paramount object of the tobacco research program are to furnish North Carolina farmers with simple, effective weapons with which to war upon the 17 or more major diseases, insects, and plant-food deficiencies gnawing at the incomes of the growers.

Quality tobacco is produced at the Oxford Tobacco Experiment Station in its program to select varieties most suitable to North Carolina conditions.

Wherever farmers have planted tobacco, some insect or disease soon finds a home to plague the producer and increase the problem of the research men. But from the "mother research farm" in Granville County, pathologists and agronomists maintain a constant watch over the tobacco - growing areas of the State and have rapidly

established research plots wherever pests and disease have struck at normal tobacco growth.

Reaching into the counties heavily hit by disease, test plots have been established at McCullers Station in Wake County, where control is being sought for root knot and southern wilt of tobacco. In Guilford County, research has brought definite results with the finding of a variety of tobacco almost 100 per cent resistant to black root rot. At Creedmoor in Granville County, some varieties have been developed that are 75 per cent resistant to the dreaded Granville wilt. In Forsyth County, an intense study is being made to thwart black shank, a disease that has already taken a toll of 50 to 75 per cent of the tobacco acreage on several farms near Walkertown in Forsyth County. Some relief has been obtained with the introduction of some tobacco selections found to be above 90 per cent resistant to black shank.

E. C. Moss, assistant director in charge of the Oxford Tobacco Station since it was founded in 1912, inspects plants that have been attacked by blue mold. His knowledge of tobacco diseases and problems is not only known and appreciated by virtually every North Carolina leaf producer, but has brought him international recognition.

Prior to 1930, there was no black shank (Phytophthora) disease prevalent, but 9 years ago it struck almost simultaneously in Quincy, Florida, and Forsyth County, North Carolina. Plants infected died within 3 to 5 days. A corps of research leaders were sent to the stricken area, where Walkertown's T. M. Lewis rented 5 acres of his land to the State for study of the flue-cured tobacco malady. Reaching into the cigar-variety sections of Florida, scientists took two cigar varieties and crossed them with flue-cured types, with the result that "some good selections," which have been described as nearly 100 per cent resistant to the disease, have been obtained. In 1937 this same disease occurred in Pitt County, and specialists from the tobacco station and college were immediately sent to the area to work cooperatively in finding a solution to the problem.

On the 12-acre Creedmoor experimental plot, hundreds of tobacco varieties have been crossed or tested in a relentless search for a solution to Granville wilt, a disease that was known only in a small area in the southern part of Granville County 30 years ago, but which has since spread all over the State. Taking one variety from South America and one from Turkey, crosses with flue-cured types have brought only a 75 per cent resistant variety, but the search for further relief is continuing.

Since blue mold swept the tobacco plant beds at random throughout the State, scientists and research authorities have worked tirelessly seeking control measures. Methods employed to combat the fungus disease today include the spray method, described as

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This fine field of Ladino was seeded on the Sturtevant farm in 1931. The growth is short due to grazing and dry weather when photographed (Sept. 6, 1939). The first crop cut for hay yielded 2 tons per acre.

Ladino Clover "Sells" Itself

By Ralph W. Donaldson

Agronomist, Agricultural Extension Service, Amherst, Massachusetts

LADINO clover is gaining acreage as a pasture crop in Massachusetts. So far new seedings have doubled each successive year. With 600 acres seeded in 1937, 1,500 were added in 1938, and 2,500 acres more have been seeded in 1939. From the total of these recent seedings there should be more than 4,000 acres of Ladino stands in 1940. Yet 10 years ago this clover was unknown to farmers of this northeast region.

It was the spring of 1929 to be exact, when John Ellis, owner of a leading Holstein herd first introduced Ladino seed from Idaho to Massachusetts. That season he seeded a small patch for observation on his farm located in the Berkshire hills. The clover thrived and made a dense growth reaching almost to his knees. A 10-acre grazing trial made him still more enthusiastic. Several neighbors watching its performance were intrigued, which led in turn to others growing it. Thus the acreage has been expanding. One factor responsible for its gain in popularity unquestionably is this—Ladino "sells" itself.

Ladino clover (Trifolium repens var. Latum) resembles white Dutch except for its "giant" size. The plant once established spreads by means of surface runners which grow and root along the ground and produce the main crop of leaves and blossoms. Some notion of its spreading habit may be gained by describing its behavior in seeded rows.

These single plants, spaced 4 feet apart, produced a complete ground coverage by the end of 12 months from date of seeding.

In height of stalk and size of leaves, however, a stand of Ladino appears like one of red or alsike clover. The tall growth of this clover (6 to 20 inches) enables this plant to compete successfully with the common tall hay plants which suppress the growth of smaller pasture clovers. It is this characteristic mainly, as well as the capacity for high yields under grazing management, which attracts farmers to substitute Ladino for white Dutch in mixtures sown for grazing use.

Excellent Grazing Crop

Ladino excels as a grazing crop for dairy cows. The dense, tall growth enables a cow to fill up quickly and to produce milk efficiently with little grain. Ladino grazing compares favorably with a half-grown stand of red clover or alfalfa in this respect and is readily consumed. After perhaps an hour's grazing the cow is full with ample time to lie down and chew her cud. On the basis of Morrison's classification of grazing feeds, Ladino pasturage would seem to rate as "excellent."

According to this authority, it makes a difference what *kind* of pasturage is fed in determining the need for extra grain. For the production of 30 pounds of 4 per cent milk, for instance, he states the daily requirements for a cow may be as follows: on *fair* pasture, 10.2 pounds of grain; on *good* pasture 6.3 pounds of grain; and on *excellent* grazing only 2.4 pounds of grain. If a saving of grain feed is desired from pasture use, then the "excellent" form of it merits the emphasis.

The ability of Ladino grazing to save on grain feeding has helped to make this crop attractive to farmers in this area where all grain is purchased and is expensive.

Ladino seems to yield more grazing to the acre than is common from other crops. One of the apparent reasons for its yield of pasture feed is the ability of its plants to recover rapidly after the growth is cropped.

During favorable periods for its growth, a 2-week interval normally is sufficient for recovery of adequate growth for regrazing. It is only during seasonal periods of deficient moisture that longer intervals may be needed for recovery.

During the spring period of greatest growth, a good stand of Ladino will usually require 8 to 10 cows to the acre for about a week to crop it down. While several inches of growth still remain, the animals should be moved to a second area. To have at least three such smaller areas, each of the size to accommodate the herd on the basis of about 10 cows to the acre, gives opportunity for rotation and rest intervals which are important for best results. Any surplus lots of feed during the early part of the season may be cut for hay or be ensiled for August feeding.

While the spring flush of growth may afford a carrying capacity as high as three cows to the acre for several weeks or more, yet reduced growth in later months may lower the carrying capacity to less than one cow to the acre, depending largely on the moisture. To secure good grazing during a 150-day period, 1½ cows to the acre has been

Ladino furnishes this cow luscious grazing on the Sturtevant farm. Sept. 6, 1939.

The initial stand after seeding is predominantly red clover and may be cut for hay. H. Lindsey farm, June 20, 1939.

the figure usually employed in estimations.

Ladino also appeals to farmers because it can be established simply. The same cultural and fertility practices required for seeding of red and alsike clovers are suitable for Ladino. The same seeding mixture employed for establishing a hay crop may be used. The only new effort involved is to see that one or two pounds of Ladino seed are included in the mixture for an acre. Nor is it necessary even to inoculate the seed.

Moreover by seeding Ladino with a common mixture, the farmer incurs no added risk if this clover should fail to grow. There still remains the normal expectancy of crop from his customary seeding.

Some consideration should be given, however to the matter of selection of areas for seeding to Ladino. It is well to avoid the drier soils and to select areas of better moisture. Adequate moisture is important to the growth of this shallow-rooting plant. Soils moist enough for alsike or the smaller pasture strains of clover generally are most suitable for the seeding of Ladino. The plants tend to be shorter lived on the drier soils than on the wetter soils.

Ladino extends the period of productive clover growth in mixed seedings an extra year or so by filling in the place of red and alsike clovers which are shorter lived. The productiveness, in fact, may be as great for grazing when Ladino takes their place, because of its ability to recover more rapidly when grazed. The sequence of growth is somewhat as follows:

The next spring after seeding, the stand is generally a mixture of red or alsike clover with some Ladino and is suitable either for hay, or grazing; later in the season Ladino usually predominates. The second and often the third years of sod (when timothy normally predominates) may be almost solid Ladino in which case the crop is han-

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Third season Ladino growing with timothy to be cut for hay then grazed. H. Lindsey farm, June 20, 1939.

Why Are Corn Belt Soils Becoming Low in Available Potash?

By George D. Scarseth

Soil Chemist, Purdue Agricultural Experiment Station, Lafayette, Indiana

¶*Third of a series of practical articles dealing with the principles of soil fertility.*

IF you stood leaning against the wall of the First National Bank that had a million dollars in its vaults, and you had only one dime in your pocket, there would be a total of one million dollars and ten cents within the circle of the bank and you. However, as for you, only one dime of this great total would be available for your immediate use. A soil may have a total of 40,000 pounds of potash stored within an area of 1 acre to a depth of 6 inches, but have only 100 to 600 pounds or less potash held in such a way that plants can get it.

The potash that is unavailable to plants is firmly locked inside of the rock and clay particles of the soil and is dependent upon years of weathering to be made available. The relatively small amount that is available is loosely held and is called exchangeable. It is this exchangeable potash that needs to be replenished in crop growing processes, or soils will be exhausted for available potash, even though the total insoluble quantity is great.

How Potash Is Held by a Clay Soil. Potash will leach through sands that have little or no clay content or organic matter as easily as sugar would wash through such soils. But soils that contain clay or well-decomposed organic matter (humus and lignin) will hold the potash in such a way that it won't easily be lost by leaching, but will be available to plants.

The diagram shows how potash is held in the soil. The mineral clay particle, containing the bulk of the insoluble or unavailable potash in the soil, is shown with a ragged or honeycombed weathered surface. The potash in this honeycombed zone is only slowly soluble, but more so than the potash inside of the solid clay particle. Around the clay particle is a "thick" (thin in common terms) layer of water that is adsorbed or compactly held to the surface of the clay. (An air-dry sand may contain only 1.5% moisture, whereas an air-dry heavy clay may contain as much as 20% moisture. Both may seem dry, but the greater moisture in the clay is associated with these water films or layers on the surfaces of the clay particles.) Inside this film of water around the particle and in between the mineral layers of the honeycombed surface of the clay particle, the available (exchangeable) potash is held. A soil that is fertile with respect to potash will have 300 to 600 pounds per acre of potash held in this manner. When the soil contains 200 or less pounds of exchangeable potash per acre, additional potash will be needed by most crops.

Plants Feed on Adsorbed Potash. The root hairs of the plants come in close contact with the water films of the clay particles and are able to remove the potash from the film and take it into the plant. When this occurs, a particle (ion) of hydrogen from the water and carbon-dioxide-saturated root juice (carbonic acid and plant-food salts) leaves

the plant and takes the place in the film formerly occupied by the potash particle. This process is known as an ionic exchange (base exchange). The root hair also receives potash from the soil solution, but the soil solution does not contain many free particles of potash. The potash in the soil solution and in the water-films around the clay and black organic particles exist in a balanced condition; thus when a potash particle is removed from the soil solution, a potash particle from the water film moves out into the soil solution in such a way that a balance is always maintained (ionic equilibrium). There are other plant-food materials, as calcium and magnesium, in the water film that behave in much the same manner as the potash.

Available Potash Supply Decreasing. A virgin soil is usually rich in available (exchangeable) potash because, beside the clay particles to hold potash, black organic matter will also hold potash for plants. The residues from roots, leaves, and plant bodies that contained potash which had been pumped back to the surface as it tended to be lost by slow leaching helped to keep virgin soils rich in potash. The losses sustained by crop removal are great enough to exhaust most soils in a period of a few years, particularly if the crop residues or manures are not conserved and returned. Even with manures returned, the potash loss will be great, because much of the liquid of manures and animal excrement naturally rich in potash is lost. The amount of potash in the urine excreted by a cow in 1 year has been estimated to be equal to two 100-pound bags of muriate of potash.

At the Indiana Station, various soils fertilized over a period of 25 years with complete fertilizers carrying a moderate

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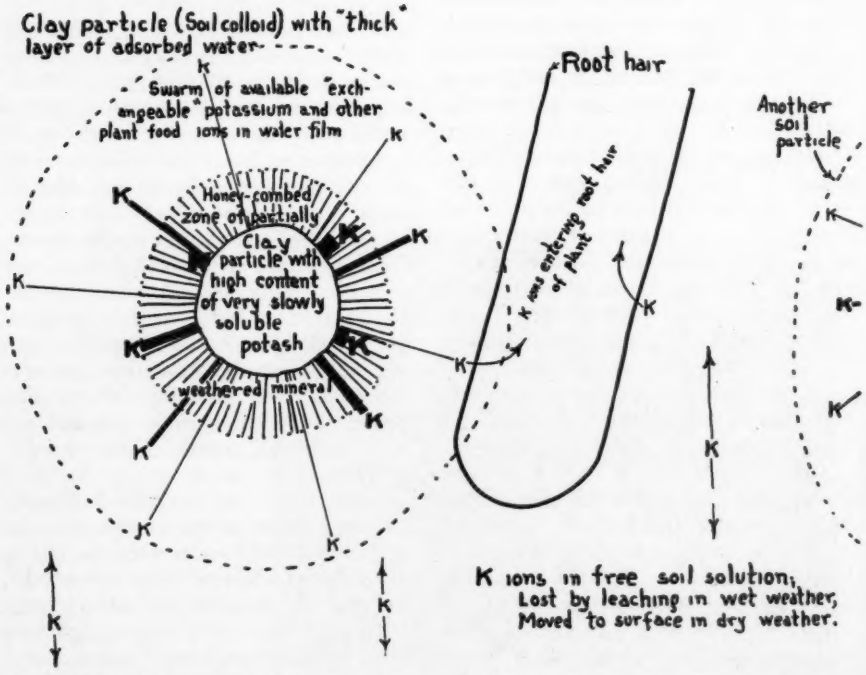
Clay particle (Soil colloid) with "thick" layer of adsorbed water
Swarm of available "exchangeable" potassium and other plant food ions in water film
Honey-combed zone of partially
Clay particle with high content of very slowly soluble potash
weathered mineral
Root hair
K ions entering root hair of plant
Another soil particle
K ions in free soil solution;
Lost by leaching in wet weather,
Moved to surface in dry weather.

How potash is held by the clay in a soil. The symbol K represents the potassium particle (ion). The K particles are adsorbed on the surface of the clay and the strength of the bond holding the K to the clay is represented by lines of various thickness—the thicker the line, the stronger the bond.

How Shall We Fertilize Vegetable Crops?

By Victor A. Tiedjens

Agricultural Experiment Station, New Brunswick, New Jersey

RESULTS from investigations to determine the best method of applying fertilizer for row crops during the past season on 17 vegetable farms indicate in each case that plowing under chemical fertilizers gave as good or better yields than the growers' methods which consisted of either row, side-dressing, broadcasting, or combinations of several methods. These tests were made on light to medium heavy soils which were fair to good for lime and pH.

The biggest yields of tomatoes on fertilizer plots at the New Jersey experimental farm at New Brunswick during the past three growing seasons were obtained where two-thirds to all of the fertilizer was broadcast before the ground was plowed. Where either 500, 1,000, or 1,500 pounds of 5-10-10 fertilizer were placed in 2-inch bands, 1 foot long and 4 inches from the plants on either side, the yields were lower by 4 tons than where the fertilizer was plowed under. Broadcasting all the fertilizer after plowing or half of it and applying the remainder as two side-dressings, or placing the superphosphate under the row and applying the nitrogen and potash as side-dressing fell short of the highest yield by 1 to 3 tons.

These results were obtained on a soil having a pH of 6.2 to 6.4. On acid soil the same plots might have produced differently. The maximum yield was 14.5 tons of tomatoes. The method that would prevent rapid fixation of the phosphoric acid undoubtedly would have produced the largest yields. The band method probably would show up much better. However this is not necessarily the case for all crops.

Sweet potatoes, which also must be grown on acid, sandy soils to prevent ground diseases from making the crop unmarketable, have not produced particularly good yields by the banding methods in comparison with other methods in experimental plots on Fred Bateman's farm at Grenloch, New Jersey. In 1939 sweet potatoes where the fertilizer was all applied as a side-dressing 2 and 5 weeks after the plants were set produced 150 bushels more than where the fertilizer was applied in bands.

All of our vegetable crops except the two potato crops will tolerate lime and will do particularly well at a pH of 6.5 on mineral soils. At those pH values we probably need not concern ourselves with the availability of phosphoric acid.

The Band Method

The fact that the band method has produced the same yields with one-half the fertilizer does not seem to be any particular advantage. If the facts were known, we might just as correctly assume that the grower was using too much fertilizer and in so doing burned the roots of his plants. It seems that we have not studied enough plots to know the truth. The banding method does prevent root injury where seed is sown. Where plants are set, as with sweet potatoes, it seems that even this method of applying fertilizer retards the growth, even though the fertilizer is not in direct contact with the roots.

Our light sandy loams and loamy sands present another problem because of the ease with which soluble salts leach during periods of heavy rainfall. On such soils our concern is not to prevent fixing of phosphoric acid but of supplying fertilizer in sufficiently small quantities to prevent salt injury and at intervals frequent enough to supply the needs of the plants.

The method of applying fertilizer that will produce the best results for our crops will depend on phosphoric acid availability for those crops which must be grown on acid soils, uniform distribution of fertilizer for those crops that will do best on well-limed soils, and frequent application of small quantities for those crops which are grown in sandy soil. Fertilizer injury must be prevented in each case. Furthermore, we must keep in mind the cost of the fertilizer applied to the crop in each case.

Tomatoes like this grew in a field where the fertilizer was plowed under.

Plowing under animal manures was always considered wise practice and good assurance that a worthwhile crop would be grown. The manure was applied to the surface and plowed under with refuse, cover crops, or grass sod. It contained plant food that was released gradually as the crop grew. The area that was covered was determined by the amount available. Very often the field was only partly covered, and the crop that followed showed where the dividing line was. Generally the manure was applied for the cash or vegetable crop in a rotation, a field receiving manure only once in 3 or 4 years. Yields were not estimated on the basis of the amount of manure applied, but according to the time the crop was planted, the particular season, or on how well the ground had been prepared.

There have been many arguments regarding the method that would make the best use of manure. Who has not seen the result of hauling manure to the field and distributing it in small heaps to be spread by hand several weeks or months later? The outlines of these piles were visible several years later. It was considered poor management. But when we see the effect of row applications of chemical fertilizers several years later in the growth made from the residual fertilizer, we shrug

our shoulders and say it is inevitable. I wonder whether it is? The manure spreader put an end to the manure heaps. Perhaps we need a broadcasting machine to put an end to the uneven growth from row applications of chemicals.

There was no question regarding the efficacy of manure for growing crops, and the question of toxicity or burning was never thought of. It could be used as a top-dressing on meadows and pastures by spreading it evenly over the surface, or it was plowed under for cultivated crops. Very often it was plowed under in the late summer or early fall for the crop the following spring. In spite of plowing it all under, good crops could always be expected from manure. But when we use chemical fertilizer we feel that we have to apply this plant food as close to the crop as possible when it is planted. I wonder whether this is necessary.

As far as the vegetable grower is concerned, the use of chemical fertilizer probably began with the use of superphosphate as a supplement to manure, although numerous other materials had been added to soils more or less spontaneously, in the early history of plant nutrition. Substituting chemicals for manure built up a need for research to determine the best method of applying these chemicals, and up to the present time the great bulk of these investigations has been based on the idea of applying the fertilizer on top of the plowed ground rather than deeper in the soil where the roots must function.

These tomatoes grew in a field where the fertilizer was broadcast after plowing.

The use of chemicals marked the beginning of trouble for the farmer and work for the Agricultural Experiment Stations. Tests and experiments were established to compare the value of chemicals with manure. Only in recent years has the acidity of the soil been taken into consideration in such investigations. Very often the fertility level of the soil has been ignored.

Many investigations were established on soils containing too much fertility, and contradictory results were obtained. The condition of the field was not mentioned when a report of the experiment was made. Where differences were obtained, manure usually gave best results, particularly if it was supple-

mented with a small amount of superphosphate. Minor elements of course played no part, because of the manure that had been used in the past. Lime was considered as a soil amendment and not a plant food. Manure contained enough calcium and magnesium to go around. Even acid soils produced good crops with manure, because toxic materials were absorbed by the manure.

New Problems Arose

Intensive vegetable production probably was responsible for the complete substitution of chemicals for manure. Manure became scarce. A few hundred pounds of chemicals substituted for manure were gradually increased by leaps and bounds. If a little was good, more was better; and finally manure was considered unnecessary, particularly since it was difficult to get. For a time chemical fertilizers gave startling results. Gradually, as the residual manure and lime were being exhausted, it required more fertilizer to get the necessary kick. And if the story were known, fertilizers were used in greater quantities, not because a complete fertilizer was needed, but because phosphorus or potassium or calcium was getting too low.

To add to the difficulty, the chemicals were used near the plants, and as the amounts increased, the roots became injured. Everything was blamed except the fertilizer. Plant pathologists, entomologists, crops specialists, and even economists were called in to diagnose the farmer's problem. All because he tried to grow plants in an unbalanced brine solution around the roots. If the plants were not injured directly, the large amount of plant food in close proximity to the roots restricted root growth, and dry weather took more than the usual toll. The tops grew abnormally, and the plants did not set fruit or were more susceptible to disease organisms.

From 1,500 to 2,000 pounds of soluble plant food per acre was and is being applied to the row under tomatoes and similar crops. Residues began to be built up which interfered with good root action. If the application of the fertilizer was followed by a heavy rain, the mortality of plants was reduced. If the plants were set in after the soil was cultivated but before a heavy rain, it was necessary to replant the crop.

About this time methods of applying fertilizers were questioned, and new methods were suggested. But in many of these methods, for some reason or other, the idea was to keep the fertilizer as close to the plant as possible without injuring the roots. Placing all the fertilizer under the row of plants resulted in a rapid growth if they escaped injury. If a season of ample rainfall prevailed, the plants grew soft and succulent, and in the case of the tomato made an extensive growth. They became crowded in the row and failed to set fruit until late in the season. There was much more foliage than was needed to produce a good crop of fruit. Very often collar rot or other disease-producing organisms set to work in the created shady, moist environment and killed the plants before they could mature their fruit. What should have been a 20-ton yield often turned out to be less than a ton to the acre.

Fertilizer Plowed Under

Cabbage grown under the same conditions made a tremendous yield, because foliage was what was needed for a marketable crop. Pritchard and Bonney Best tomatoes produced much larger yields under those conditions than did Rutgers or Marglobe. On the other hand Rutgers and Marglobe did much better during dry years when the fertilizer was not readily available to them.

Plowing under chemical fertilizers has not been adopted as a practice, and little research work has been done on it. Why shouldn't fertilizer plowed under produce as good yields as any other method of applying plant-food material? It is a method that can be used for most crops in any rotation. Further-

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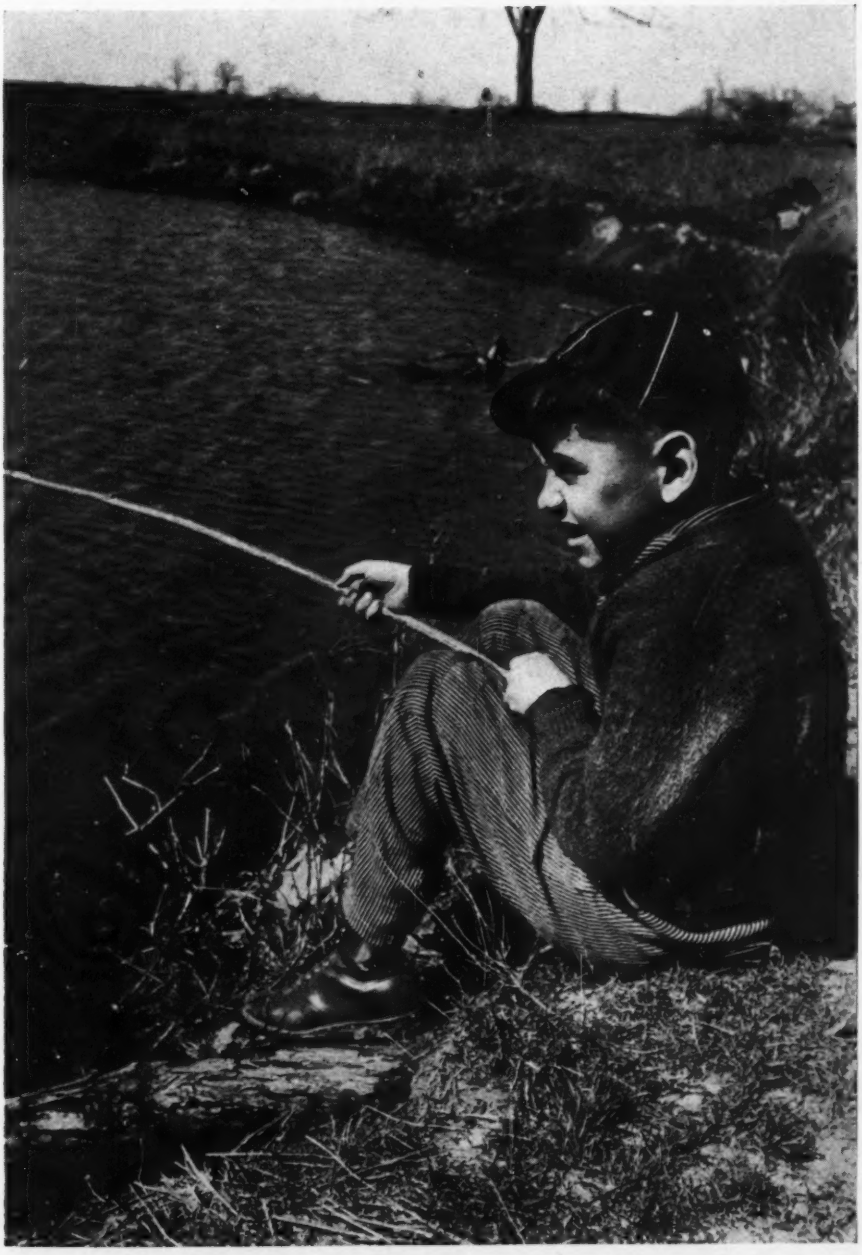
PICTORIAL



WHERE A FELLOW CAN FORGET THE CARES THAT BESET HIM

Wheat storage facilities feed grain to the miller as he needs it and hold the surplus till the farmer can sell at a profit.

Spring finds man and beast glad to get back to the soil, even though tasks may be arduous and hours long.

Left: A penthouse for two, or three, or four.

Below: A field of apricots stage an opening in California.

The Editors Talk

Friends of the Land

Mustering to defense against America's public enemy No. 1 (The Alarming and Rapid Depletion of Our Soil), fifty-two citizens of thirty-eight States met in Washington, D. C., March 22-23 and organized a new society, "Friends of the Land." Non-profit and non-partisan, the purpose of the organization is to support and forward the unified conservation of "soil, rain, and man."

In the discussions which crystallized interest into formation of this new society, the stark facts of the wastage in fertile top-soil and water, which has already in countless instances necessitated the migration not only of single families but whole communities, were laid bare. Shocking evidence of the deterioration of once prosperous sections was presented from first-hand sources.

Organized outside of the Government, "Friends of the Land" will seek subscriptions and backers among citizens in general, both within the Government and without. "The land is all of one body. We, too, are all of one body. In country and city, in trade or in science, in good times and in hard times, we all live on, or from, the soil. . . . So long as we continue scrubbing off top-soil and fouling water sources, business and social conditions in this country will remain fundamentally unsound."

Tentative objectives set forth by the Society for the conservation of land and water resources in the United States include:

"1. Assembling information regarding the economic, industrial, and social need for conserving our land and waters; placing before the people of the country various issues and problems in land and water conservation; and forwarding in the interests of the public, specific policies of conservation.

"2. Encouraging the organization of affiliated regional and local groups.

"3. Preparing and making available to membership and to the general public a monthly magazine, THE LAND, and other literature on the technique, importance, and significance of soil and water conservation, and recommending to our members suitable literature prepared by other organizations, operating in special fields.

"4. Fostering investigation, exploration, research, and experimentation into the science of soil and water conservation, and recognizing achievements in this field by electing outstanding scientists as honorary members of the society, or by special awards.

"5. Encouraging and furthering the practice of land and water conservation by individuals, cooperative groups, States and subdivisions thereof, and the Federal Government, and promoting legislative measures and the efficient and economical use of public funds in furtherance thereof.

"6. Recognizing outstanding accomplishments in land and water conservation by farmers, soil conservation districts, and other local groups, by suitable citations and awards.

"7. Promoting inclusion in the curricula of our educational systems of courses on the significance and technique of land and water conservation.

"8. Fostering the participation of the youth and youth organizations and especially unemployed youth, in a moral equivalent against wastage of soil and water.

"9. Cooperating with other organizations interested in the conservation of trees, grass, wildlife, and people in promoting common objectives.

"10. Convening periodical conferences in various parts of the country to obtain wider recognition that soil wastage threatens our institutions."

The perspective of the organization does not lose track of international cooperation. A clearing house of information on conservation in foreign countries and a World Conservation Congress are among objectives in this field.

Whole-hearted sympathy with the aims and purposes of the new organization and sincere wishes for its success and growth into an influential agency must come from everyone who stops to review the effect of depletion of the soil upon past civilizations and to realize what can happen to ours if ruinous wastage is not checked. But sympathy and wishes do not in themselves produce results. Active cooperation wherever possible should be freely given. "The problem is facing America today. It cannot wait."

To Know Your Soil

The increasing interest of farmers and home-owners to know more about their farm, garden, and lawn soils in terms of productive fertility is influencing more and more States to establish adequate services to promptly and effectively furnish this information. Recently, announcement of a new service set up on a fee basis in the department of agronomy of the University of Illinois College of Agriculture was made by Dr. W. L. Burlison, head of the department.

The announcement states that the establishment of the service is seen as a decided boon in the conservation and improvement of the State's greatest natural resource—its soil. It is estimated that in the interest of sound soil conservation, there is needed on the farms of this State a total of about 45 million tons of limestone and, in addition, thousands of tons of phosphate and potash.

Replacements on this scale are needed in order to bring Illinois soils back to a level of efficient and profitable production after the depletion of fertility which has taken place through natural leaching and 100 years or more of intensive cropping. However, the needed materials can be applied economically and profitably only through careful and accurate tests such as will be possible in the new testing service. These tests will reveal where the materials are needed on a given field and how much of each of them should be applied to correct soil deficiencies.

From this announcement, it should not be implied that heretofore Illinois has done no soil testing. Much has been done through county farm advisers, county farm bureaus, and the extension service of the agricultural college largely on an educational basis. Despite the volume of this testing, it has fallen far short of meeting the need and demand for such service, according to Dr. Burlison. It is not intended that the new service will in any way curtail or replace the testing service now being given by county farm advisers and others. It is designed merely to care for overflow requests.

States which are taking steps to adequately service the increasing demand of land-owners to know more about their soil are to be congratulated for a foresightedness in keeping with the new interest in rebuilding and maintaining the fertility of American soils. The longer our soils are cropped, the greater will be this demand. An aroused public consciousness of soil conservation is one of the outstanding developments of this Nation's agriculture.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ Supplementary to the efforts of the Virginia Extension Service in pointing out to farmers of the State the practicality of high analysis fertilizers is the simple story given in Circular E-348, "More for Your Money from Tobacco Fertilizers." The theme stresses the importance of using the recommended 3-8-6 or 3-10-6 analysis, showing that the many tobacco growers who continue applying 3-8-3 lose considerable of their potential income.

In a 6-year study on a typical tobacco soil, the circular states that the 3-10-6 fertilizer gave an additional return of $22.16 over 3-8-3 when each was applied at the rate of 1,000 pounds per acre. In other words, $1.96 worth of additional plant food (20 pounds P_2O_5 and 30 pounds K_2O) produced an average of 1,040 pounds of tobacco per acre, worth $207.43, contrasted with 992 pounds valued at only $185.27 where the 3-8-3 was used. The net profit obtained, therefore, was $20.20 from the 3-10-6 over 3-8-3. This extra return more than pays the entire cost of the recommended tobacco fertilizer by $6.79, these data prove.

From the figures presented, the extension authorities say it is obvious that the average tobacco producer would make money if he bought a 3-10-6 fertilizer rather than used a 3-8-3, even if it were given to him.

¶ Timely suggestions on the fertilization of field crops, vegetable crops, and tree and small fruits are given in the Pennsylvania Experiment Station latest revised leaflet, "Fertilizers Recommended for the State of Pennsylvania." The listings and brief suggestions pertaining to the fertilizers advised according to soil characteristics under different soil management are based on Station Circulars 138 and 208, which contain more detailed information concerning fertilization of these crops.

Notable among the changes is the listing of 5-10-10 for potatoes, beets, carrots, parsnips, asparagus, rhubarb, spinach, and for the home garden crops on sandy loam soils where no manure is used. In addition to 4-8-12 for tobacco, 3-8-12 and 3-8-16 are now recommended, and where manure is used it should be well rotted. Fresh manure may be applied to the preceding crop in the rotation.

Potatoes tending toward excessive vine growth on rich, heavily manured soils should receive a 3-12-6 or preferably 4-12-12. If the growth of cover crops in the orchard is vigorous and is not removed, an annual application of 200 to 250 pounds of 10-6-4 per acre in early spring should maintain productiveness and vigor of both trees and the cover crop. Fertilizer specifications for the small fruits are essentially the same as contained in previous publications.

"Pointers in Fertilizing Papaya," Agr. Ext. Serv., Honolulu, Hawaii, Agr. Ext. Cir. 61, Feb. 1940, Ashley C. Browne.

"What Fertilizers and How Much to Give Seedlings in Cans," Agr. Ext. Serv., Honolulu, Hawaii, Ext. Cir. 62, Feb. 1940, Ashley C. Browne.

"Fertilizer Placement," Agr. Ext. Serv., Honolulu, Hawaii, Ext. Cir. 64, Feb. 1940, L. A. Dean.

Soils

¶ H. E. Hendricks, in Tennessee Extension Publication 233, "How to Build

and Conserve Your Soil With the Aid of the AAA," informs Tennessee farmers that their land is now being called upon to support 60 per cent more farm families than it supported 50 years ago. During this period the acreage per farm has decreased 66 per cent, resulting in more frequent cropping and depletion of the land. To build and maintain the fertility of the land under more intensive farming, with greater financial burdens of present-day agriculture, necessitate that every soil-building practice fitting in a given field be carried out and integrated into a soil-conserving system of farming, according to Professor Hendricks.

Five major land problems, which have been caused by misuse or natural forces, are prevalent over the State as a whole. Some of the several recognized practices for their correction are discussed concisely. Under use of proper soil amendments—liming, the use of phosphate and potash — the author points out the rates of payment allowed by the AAA for such practices that make a soil-conserving, cropping system possible. Unit payments for carrying out other recognized practices are also discussed. These include control of water run-off and erosion by mechanical means, wider use of soil-building crops, vegetative cover for bare crop land during winter months, and proper use and management of idle and abandoned land.

Excellent illustrations depicting the accomplishments of sound soil management, as well as those portraying the opposite when certain soil conservation practices are neglected, go a long way in clarifying the purpose for which these adjustment practices are designed.

"Soil Survey, Toombs County, Georgia," U. S. D. A., Washington, D. C., Series 1935, No. 11, Oct. 1939, Arthur E. Taylor, W. H. Buckhannan, A. H. Hasty, and John T. Miller.

"Soil Survey, Marion County, Iowa," U. S. D. A., Washington, D. C., Series 1932, No. 39, Oct. 1939, C. L. Orrben and W. J. Leighty.

"Soil Survey, Cheboygan County, Michigan," U. S. D. A., Washington, D. C., Series 1934, No. 15, 1939, Z. C. Foster, A. E. Shearin, C. E. Millar, J. O. Veatch, and R. L. Donahue.

"Soil Survey, Schoolcraft County, Michigan," U. S. D. A., Washington, D. C., Series 1932, No. 37, Sept. 1939, Z. C. Foster, J. O. Veatch, L. R. Schoenmann, R. E. Pasco, E. H. Hubbard, and R. L. Donahue.

"Soil Survey, Kanabec County, Minnesota," U. S. D. A., Washington, D. C., Series 1933, No. 27, Aug. 1939, P. R. McMiller, Iver Nygard, Sam Hill, A. E. Shearin, C. S. Simmons.

"Soil Survey, the Lower Yellowstone Valley Area, Montana," U. S. D. A., Washington, D. C., Series 1932, No. 38, Sept. 1939, William DeYoung, F. K. Nunns, and L. H. Smith.

Crops

¶ Ohio Experiment Station Bulletin 611 entitled, "Deficiency Symptoms of Greenhouse Flowering Crops," by Alex Laurie and Arnold Wagner, details the visual symptoms of nutritional deficiencies for the more important greenhouse plants and should be of much value to growers in diagnosing and correcting these malnutritional disorders in time to save the affected crop. The symptoms exhibited by the plants studied and summarized in this publication agreed in general with each other and with the symptoms noted by other investigators on other crops. The plants investigated were *Begonia, Calceolaria,* Carnation, *Chrysanthemum, Cineraria, Fuchsia, Gardenia,* Geranium, *Hydrangea, Poinsettia, Primula,* Rose, Snapdragon, and Sweet Pea. The general nutrient deficiency symptoms studied relate to the following elements: nitrogen, phosphorus, potassium, magnesium, calcium, iron, manganese, sulfur, and boron.

The authors state that "since these visual symptoms frequently develop long after retardation of growth has begun, it is very important that early diagnosis be made and corrective measures taken. Although it is true that these measures may have their desired effect after striking symptoms have developed, still it is advantageous to forestall serious stunting of growth by early observation."

¶ Following the trend of a few other State agricultural experiment stations in publishing journalistic periodicals on farm research is the newly instituted "Farm and Home Science," the Utah

Experiment Station Quarterly, Volume 1, Number 1, of March 1940. This consists of 12 pages, replete with instructive material to acquaint farm and home people of the progress being made at their experiment station, and to make available to them in non-technical terms the results of this research. Director R. H. Walker and Editor Gladys L. Harrison state that while this publication is intended for the rural people, anyone interested in the work of the station may receive it.

"Kudzu, Its Value and Use in Alabama," Agr. Exp. Sta., Auburn, Ala., Cir. 83, Dec. 1939, D. G. Sturkie and J. C. Grimes.

"Report of the Minister of Agriculture for the Dominion of Canada for the Year Ended March 31, 1939," Ottawa, Ontario, Canada, 1939.

"Division of Illustration Stations, Progress Report 1934 to 1938, Part 11, Manitoba, Saskatchewan, Alberta, and British Columbia," Dept. of Agr., Dom. Exp. Farms, Ottawa, Ontario, Can., 1939, J. C. Moynan.

"Fifty-second Annual Report 1938-39," Agr. Exp. Sta., Fort Collins, Colo., 1939.

"Dahlia Variety Test—1939," Agr. Exp. Sta., Experiment, Ga., Cir. 120, Dec. 1939, H. L. Cochran, David D. Long, and Norman La Motte.

"Report on Agricultural Research for the Year Ending June 30, 1939, Part 1, Project Reports, Publications, Staff Financial Statement," Agr. Exp. Sta., Ames, Iowa, 1939.

"Report on Agricultural Research for the Year Ending June 30, 1939, Part 11, Iowa Corn Research Institute Fourth Annual Report," Agr. Exp. Sta., Ames, Iowa, 1939.

"1939 Iowa Corn Yield Test," Agr. Ext. Serv., Ames, Iowa, Bul. P2, Feb. 1940, Joe L. Robinson and Marcus S. Zuber.

"The Massachusetts Commercial Vegetable Grower," Agr. Ext. Serv., Amherst, Mass., No. 24, Mar. 1940.

"Reed Canary Grass for Meadows and Pastures," Agr. Ext. Serv., Univ. Farm. St. Paul, Minn., Ext. Bul. 137, Dec. 1939, A. C. Arny.

"Annual Report of Cooperative Extension Work in Agriculture and Home Economics, Mississippi, 1938," Agr. Ext. Serv., State College, Miss., Ext. Bul. 105, Feb. 1939.

"Mississippi Farm Research," State College, Miss., Vol. 3, No. 3, Mar. 1940.

"Research in Agriculture, Work of the Agricultural Experiment Station During the Year Ending June 30, 1937," Agr. Exp. Sta., Columbia, Mo., Bul. 413, Jan. 1940, F. B. Mumford and S. B. Shirky.

"The Sunrise Red Raspberry," Agr. Exp. Sta., New Brunswick, N. J., Cir. 397, Sept. 1939, Geo. M. Darrow and J. H. Clark.

"The Boron-Deficiency Disease of Apple," Cornell Univ. Agr. Ext. Serv., Ithaca, N. Y., Bul. 428, Feb. 1940, A. B. Burrell.

"The Calcium Content of the Foliage of Forest Trees," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Memoir 228, Dec. 1939, Robert F. Chandler, Jr.

"Selection, Care, and Planting of Nursery-grown Fruit Trees," Agr. Exp. Sta., Geneva, N. Y., Cir. 188, Jan. 1, 1940, H. B. Tukey.

"Department of Agriculture of Oregon Bulletin," St. Dept. of Agr., Salem, Oreg., No. 99, Mar. 1940.

"Zinnia Field Trials, 1939," Agr. Exp. Sta., State College, Penn., Bul. 386, Dec. 1939, E. I. Wilde and Conrad B. Link.

"Cassava Industry in the Philippines," Com. of the Philippines, Dept. of Agr., 25482, Manila, P. I., 1939.

"The Coconut Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25488, 1939.

"Tobacco Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25478, 1939.

"Derris Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25477, 1939.

"Rice Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25475, 1939.

"Mango Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25480, 1939.

"Peanut Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25479, 1939.

"The Abacá Industry in the Philippines," Com. of the Philippines, Dept. of Agr., Manila, P. I., 25487, 1939.

"The Minerals of Wheat and Their Relationship to Human and Animal Nutrition," Agr. Exp. Sta., Logan, Utah, Cir. 113, Jan. 1940, J. E. Greaves.

"Department of Agriculture-Immigration of Virginia," St. Dept. of Agr., Richmond, Va., Bul. 379, Mar. 1940.

"Lespedeza Sericea and Other Perennial Lespedezas for Forage and Soil Conservation," U. S. D. A., Washington, D. C., Cir. 534, Nov. 1939, A. J. Pieters.

"The Annual Lespedezas as Forage and Soil-conserving Crops," U. S. D. A., Washington, D. C., Nov. 1939, Cir. 536, A. J. Pieters.

"Growing Buckwheat," U. S. D. A., Washington, D. C., Farmers' Bul. 1835, Nov. 1939, K. S. Quisenberry and J. W. Taylor.

"Crops Against the Wind on the Southern Great Plains," U. S. D. A., Washington, D. C., Farmers' Bul. 1833, Dec. 1939, Glenn K. Rule.

"Forestry and Permanent Prosperity," U. S. D. A., Washington, D. C., Misc. Pub. 247, Dec. 1939, R. F. Hammatt.

Economics

¶ State reports relating to fertilizer consumption from Illinois are becoming

more and more interesting to the industry, in view of the fact that fertilizer tonnage has shown a marked increase during the past few years. For instance, the tonnage of mixed fertilizers increased from 12,024 tons in 1934 to an estimated total of 32,296 tons for 1939. Detailed records of changes in fertilizer consumption in Illinois are available by virtue of the fact that the Department of Agronomy at the University of Illinois has for some time been publishing data with respect to fertilizers sold in the State.

In 1939 the 2-12-6 was the leading analysis sold, representing 29.2% of the total, next in importance was 0-12-12, representing 10.1% of the total, followed by 3-12-12, 2-8-16, and 0-8-24. This is somewhat different than in 1934 when, according to the report for that year, 2-12-2 was the leading grade, 4-8-6 was second, 2-12-6 was third, 0-16-6 was fourth, and 0-12-12 was fifth on the list.

In 1939 there was a substantial tonnage of fertilizer materials sold in addition to the mixed goods previously noted. Total material sales amounted to 8,377 tons, making the total for all fertilizers not including rock phosphate 40,673 tons which compares to 18,977 tons in 1934. The sale of materials has not registered the same proportional increases that mixed fertilizers have. In 1937, for instance, tonnage of materials sold was actually greater than in 1939, although total fertilizer sales were about 4,000 tons less. It appears, therefore, from the reports that the trend in the State is toward mixed goods rather than materials.

The weighted average analysis of the 10 leading grades in 1939 was 1.9-12.0-9.6. According to the 1939 report, nitrogen has remained fairly constant since 1935, with phosphates increasing from 11.2 units per ton to 12.0, and potash from 9.2 units to 9.6. Most of this increase has occurred since 1938.

¶ Like Illinois, Wisconsin is also in the early stages of development in the use of fertilizers. According to the Wisconsin Department of Agriculture Bulletin No. 211 "Commercial Fertilizers—1940," by Walter B. Griem, total fertilizer sales in 1939 in Wisconsin amounted to 42,623 tons, slightly less than in 1938 but still considerably higher than the level prevailing during the twenties. In Wisconsin the leading single analysis of mixed fertilizer in 1939 was 2-12-6 with 11,031 tons, followed by 3-12-12 with 6,428 tons, and the next three leading analyses were 0-20-0, 0-20-10, and 3-9-18.

It is extremely interesting to notice the changes that have taken place since 1928 with respect to the complete fertilizers. In 1928 the leading five analyses represented 51% of the tonnage with 2-12-2 as the leading single analysis representing 29%. In 1939 the five leading analyses represented 85% of the total tonnage with 2-12-6 as the leading grade with 39% of the total, and 2-12-2 is no longer of importance. In the phosphate and potash fertilizer list 0-9-27 has shown a marked increase in importance, 0-12-12 has declined, 0-14-14 has also declined, and 0-20-20 has shown considerable increase, with 0-20-10 registering the greatest increase in tonnage of all phosphate and potash fertilizers.

"American-Egyptian Cotton, Utilization, Supplies, and Prices," Agr. Exp. Sta., Tucson, Ariz., Bul. 167, Jan. 1940, E. H. Pressley, Rodney Whitaker, and G. W. Barr.

"Summary of Shipments of Fruit and Vegetables from Hawaii to the Mainland, 1939," Agr. Ext. Serv., Honolulu, Hawaii, Ext. Cir. 55, Feb. 1940, Kenneth L. Hanson and Kenichi Murata.

"Report of Analysis of Commercial Fertilizers, Season 1938-39," St. Dept. of Agr. & Im., Baton Rouge, La.

"Michigan Tax Trends as Related to Agriculture," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 301, Feb. 1940, Denzel C. Cline.

"Report of Analyses of Commercial Fertilizers and Fertilizer Materials, 1939," St. Dept. of Agr., State College, Miss.

"Farm Adjustments in Montana, Study of Area IV: Its Past, Present, and Future," Agr. Exp. Sta., Bozeman, Mont., Bul. 377, Jan. 1940, Marion Clawson, M. H. Saunderson, and Neil W. Johnson.

"South Dakota Agricultural Statistics, Annual Report, 1938," St. Dept. of Agr., Sioux Falls, S. Dak., 1939.

"Range Resources of Rich County, Utah,"

Agr. Exp. Sta., Logan, Utah, Bul. 291, Mar. 1940, L. A. Stoddart.

"1940 Agricultural Conservation Program Bulletin," U. S. D. A., AAA, Washington, D. C., ACP-1940, Jan. 25, 1940.

"Report of the Associate Administrator of the Agricultural Adjustment Administration, in Charge of the Division of Marketing and Marketing Agreements, and the President of the Federal Surplus Commodities Corporation, 1939," U. S. D. A., Washington, D. C., 190094, Oct. 31, 1939.

"First Annual Report of the Manager of the Federal Crop Insurance Corporations, 1939," U. S. D. A., Washington, D. C., 186584, Sept. 13, 1939.

"Report of Federal Surplus Commodities Corporation for the Fiscal Year 1939," U. S. D. A., Washington, D. C., 190097, Oct. 31, 1939.

"Report of the Chief of the Commodity Exchange Administration, 1939," U. S. D. A., Washington, D. C., 190119, Sept. 25, 1939.

"Report of the Chief of the Sugar Division, 1939," U. S. D. A., Washington, D. C., 190096, Nov. 1, 1939.

"The Farm Outlook," U. S. D. A., Washington, D. C., Misc. Pub. 379, 1939.

"Statistics on Cotton and Related Data," U. S. D. A., Washington, D. C., Dec. 1939.

"Agricultural Marketing Service, Organization and Functions," U. S. D. A., Washington, D. C., Mar. 1940.

"Georgia Handbook, 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., SRB-401-Ga., Jan. 1940.

"Louisiana Handbook, 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., SRB-401-La., Jan. 1940.

"Mississippi Handbook, 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., SRB-401-Miss., Jan. 1940.

"Oklahoma Handbook, 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., SRB-401-Okla., Jan. 1940.

"South Carolina Handbook, 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., SRB-401-S. C., Jan. 1940.

"Texas Handbook, 1940 Agricultural Conservation Program," U. S. D. A., AAA, Washington, D. C., SRB-401-Tex., Jan. 1940.

"Here's the 1940 Agricultural Conservation Program for Connecticut," U. S. D. A., AAA, Washington D. C., NER-410-Conn., Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for Maine," U. S. D. A., AAA, Washington, D. C., NER-410-Maine, Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for Massachusetts," U. S. D. A., AAA, Washington, D. C., NER-410-Mass., Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for New Hampshire," U. S. D. A., AAA, Washington, D. C., NER-410-N. H., Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for New Jersey," U. S. D. A., AAA, Washington, D. C., NER-410-N. J., Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for New York," U. S. D. A., AAA, Washington, D. C., NER-410-N. Y., Dec. 21, 1939.

"Here's the 1940 Agricultural Conservation Program for Pennsylvania," U. S. D. A., AAA, Washington, D. C., NER-410-Pa., Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for Rhode Island," U. S. D. A., AAA, Washington, D. C., NER-410-R. I., Dec. 5, 1939.

"Here's the 1940 Agricultural Conservation Program for Vermont," U. S. D. A., AAA, Washington, D. C., NER-410-Vt., Dec. 1939.

"Land Saving Plants . . . for Conservation in the Pacific Southwest," U. S. D. A., Washington, D. C., SCS, Reg. 10, Nov. 1939.

Why Are Corn Belt Soils Becoming Low in Available Potash?

(*From page* 18)

amount of potash and producing good crop yields, with residues and manures returned, show a marked deficiency now in their supply of available potash.

The 100 years of crop production, with an accepted system of rotation and moderate fertilization, on the very productive soils of the Corn Belt, are drawing to a close. The next century will require the addition of more available potash as well as other plant foods, because the insoluble store in the soil will not become available fast enough.

Foreign and International Agriculture

To supply information on agricultural research and practice in other countries, brief abstracts of articles in foreign publications are given here. Due to space limitations, only articles of general fundamental interest are included, although the publications may contain other articles and reviews.

Die Ernährung der Pflanze, Vol. 36, No. 1, January 1940

RESULTS OF THE LONG-TIME FERTILIZER EXPERIMENT ON THE EXPERIMENTAL FIELD OF THE AGRICULTURAL EXPERIMENT STATION AT BERLIN-LICHTERFELDE. *By A. Jacob and R. Gottwick.*

Nine years' results of a potash fertilization experiment are summarized and the data for the first 7 years given in some detail. There were five series of five plots each. One plot was unfertilized and another received nitrogen and phosphoric acid only in each series. The other three plots received a complete fertilizer. In one series, three different times of potash application were compared; in the second, different rates of potash application in the form of sulphate of potash-magnesia; in the third series, three different rates of potash in the form of muriate of potash; in series four, sulphate of potash, muriate of potash, and sulphate of potash-magnesia, applied to supply equal amounts of potash, were compared; and in series five, kainit, muriate of potash, and sulphate of potash-magnesia were compared. Crops were grown in rotation on each series, with fertilization varied to suit the crop.

Considering the results of the work, the time of potash application series showed that on wheat and turnips, best results were obtained when the potash was applied four weeks prior to seeding. For the other crops grown, equally good or better results were produced by application at seeding time. Top-dressing usually was not so good as the earlier applications. The rate of application series showed that best results usually were obtained by applications of 110-145 pounds K_2O per acre, which was the medium rate. The crop grown and seasonal conditions caused considerable variation in yields, with the root crops usually giving best yields with higher potash applications. Comparing the various potash carriers showed an advantage for sulphate of potash-magnesia in most cases. This is said to be due to the marked deficiency of magnesium in the soils at the experiment station. The yield of potatoes was sometimes highest with kainit, but dry matter yield was usually higher with other carriers of potash, showing that the kainit increased the water content of the tubers. Yield of starch was always highest with sulphate of potash-magnesia. In general, yields on the unfertilized plots, or on those receiving only nitrogen and phosphoric acid, tended to decrease as the experiment continued.

The crops were analyzed for nitrogen, phosphorus, potassium, sodium, calcium, and magnesium contents. The potassium content of grain and of lupines was not influenced to any extent by potash fertilization. The potassium in the root crops and in the straw, vines, and tops of all crops usually was increased by potash fertilization. Potash fertilization tended to decrease slightly the nitrogen content of the crops. Phosphorus and sodium in the crops were not materially influenced by potash fertilization, except that the sodium content of turnip roots and tops was increased by application of potash fertilizers containing sodium chloride.

The calcium content of the tops of root crops, but not the roots, was decreased by potash applications. The calcium content of other crops was unaffected. The magnesium content of the crops was not greatly influenced, except occasionally increased by the use of magnesium-containing carriers.

The removals of nitrogen, phosphoric acid, and potash in kilograms per hectare were calculated for all treatments and crops. These show considerable variation depending on yield, treatment, and composition of crop. The large removals by turnips, sugar beets, and potatoes are very noticeable. A nutrient balance sheet for the three plant foods was calculated, balancing the nitrogen, phosphoric acid, and potash added during a 7-year period against the removals of these nutrients by the crops. These figures show that in spite of the heavy fertilization, nitrogen and potash usually showed a negative balance. The nitrogen balance would be improved some by atmospheric nitrogen fixed by the nodules on the legumes grown, and by non-symbiotic fixation, which was not determined or allowed for. The negative balance for potash was due to the increased yields brought about by the potash fertilization removing more potash than was added in the fertilizer. No manure or crop residues were added to the soil during the experiment, and the potash returned to the soil in this way under normal conditions would about balance the potash account, according to the authors. The phosphoric acid balance was positive, except where none was applied. This is due to the relatively low removal of this nutrient by the crop.

Soil Testing as a Guide to Fertilizer Usage in Silesia.

This is an abstract of two articles by Dr. Leibrandt dealing with the nutrient status of Silesian soils and its relationship to fertilizer usage. A large number of soil tests made by government and private agencies over a period of years by the Neubauer and Niklas methods have shown that 51% of the soils are poor in available potash and 72% poor in phosphoric acid. This shows that more mineral fertilizers are needed to build up the soil to the point where high yields can be obtained. It is considered that soils with 15 mg or less K_2O are poor in potash, those with 15-26 mg moderately well supplied, and those with more than 26 mg well supplied. The same relative levels for P_2O_5 are 0-4 mg, 4-7 mg, and 7+ mg respectively. The figures refer to the Neubauer method.

The author also gives the phosphoric acid and potash removals for a number of crops at two levels of yield. He says that fertilizer usage should be based on the removals by the crops, making allowance for manure additions. If the soil test shows a low content of nutrients, extra amounts of them should be supplied to build up the soil to a point where good yields can be obtained and nitrogen fertilizers efficiently utilized. For small grains, the Neubauer figures should be 25 mg K_2O and 6 mg P_2O_5, while for the hoed crops, the figures should be 30 mg and 8 mg respectively. For every mg the soil tests below these values, 27 pounds per acre of the actual nutrient should be applied. The deficiency may be made up over a period of several years, depending on economic and agronomic factors.

Potash Absorption and Water Economy in Apple Trees.

Experimental work on the influence of potash fertilization on water relationships in apple trees conducted at the Long Ashton Experiment Station in England is summarized. Leader shoots were taken from mature trees, some of which had received a complete fertilizer, and others a fertilizer lacking potash, at two locations. The shoots on the trees with potash were much longer, had more leaves, greater total and average leaf area, fewer stomata, and greater water conductivity. On the potash-fertilized trees, the superior ability of the shoots to conduct water and the fewer

stomatal openings on the leaves on these shoots indicate a more efficient water economy of the trees. This is thought to be a reason for potash-fertilized trees being better able to withstand drought conditions. The reviewer also calls attention to the work of other investigators, which showed that plants fertilized with potash had a lower water requirement than plants lacking this nutrient.

THE USE OF QUICK METHODS FOR THE DETERMINATION OF THE NUTRIENT CONTENTS OF SOILS IN THE UNITED STATES.

A summary has been made of the soil-testing survey conducted by H. R. Smalley and published in the *American Fertilizer* for February 1938. This survey showed a number of fertilizer companies were using quick tests to help determine the fertilizer needs of soils, although the limitations of such tests were recognized. In most cases, the desirability of the State experiment station conducting more testing work was expressed.

Annales Agronomiques, Vol. 9, No. 6, November-December 1939

THE ROLE OF SOIL ANALYSIS IN FERTILIZATION ACCORDING TO STATISTICS OF SOILS ANALYZED BY THE AGRONOMIC STATIONS. *By G. Barbier, France.*

The results of testing soil samples sent in to 10 experiment stations in France are summarized and critically examined by the author to see whether the tests apparently have been of aid to farmers in telling them what was wrong with their soils. The soils are tested for available phosphoric acid by the Schloesing dilute nitric acid method or, on calcareous soils, by the 2% citric acid method, and for potash by the Schloesing exchangeable potash method. The soils then were grouped into five classes based on the plant food present. Soils with less than 12 ppm P_2O_5 or K_2O were classed as very poor in the respective nutrient, those with 12-20 ppm as poor, those with 20-32 ppm P_2O_5 or 20-30 ppm K_2O as intermediate, those with 32-50 ppm P_2O_5 or 30-45 ppm K_2O as rich, and those with more than these upper limits as very rich in the nutrients.

Combining the two lower groups as poor and the two upper as rich, the figures show that 67.9% of the soils tested were poor in phosphoric acid, 11.6% were intermediate, and 20.5% were rich. In potash, 58.4% of the samples were poor, 21.5% were intermediate, and 20.1% were rich. It might be noted that the variation in phosphate content was greater, more samples testing very poor and very rich in phosphate than was the case for potash. Considering both the phosphoric acid and potash, 76.2% of the samples were poor in both, 4.8% were intermediate, and 28.5% were rich in both nutrients.

It will be noticed that very few of the soils tested fell in the intermediate group, and the majority were within the poor groups. In all probability this is due to the fact that the samples tested were from farmers who were not satisfied with the yields they had been getting from their soils. The tests indicate that the reason most of the soils had not been producing satisfactorily was a lack of phosphate or potash or both. The tests cannot be considered as giving a true picture of the fertility condition of the soils of France. The author feels, however, that the tests have been valuable in showing farmers why their fields have not been producing properly. It is concluded that soil analysis for available nutrients furnishes a good guide for the fertilization of soils, except for calcareous soils, on which further work is needed before placing too much reliance on the tests now being used.

EXPERIMENT ON THE DETERMINATION OF THE QUANTITIES OF WATER NECESSARY FOR A CULTIVATED FIELD BASED ON METEOROLOGICAL DATA. *By L. A. Reiss, Rehovoth, Palestine.*

It is stated that irrigation should supply only the water lost by evaporation

from the surface of the soil and by transpiration by plants growing on the soil. Supplying more water is wasteful, and less is likely to depress crop yield. To determine how much water to apply to meet this condition, the author measures evaporation from a surface of water by a Piche evaporimeter. Since evaporation from the soil will not be as great as from a free body of water, less than the amount lost by the evaporimeter need be applied. The author has found that only 50-60% of the Piche value is necessary. On this basis he uses a formula to calculate how much irrigation water should be applied. This formula is $H=P \times i$, where H is the water to apply, P the Piche evaporimeter reading, and i a factor, usually between .5 and .7. The Piche reading and the water applied should be in the same units of depth and time. The exact factor to use will have to be determined by experience, and will vary with soil, crop, and other conditions. The application of the formula presupposes that the soil is in a good condition so far as water supply is concerned. If the water is below optimum, enough should be given to bring the supply to a good point, and then the formula applied from that point. Overirrigation cannot be depended upon to reduce subsequent need of water, as the extra amount supplied is soon lost.

British Columbia Uses Boron for Fruit

(*From page* 11)

than the soil application. The material mixed satisfactorily with lead arsenate, but formed a heavy precipitate with lime sulphur.

In British Columbia the soil application method has been recommended and has been used almost exclusively. The boron compound is broadcast on the soil around the tree either by hand or with a hand grass seeder. In using the seeder the material is first screened through a wire mesh to remove any lumps. It has not been found necessary to work the material into the soil. Fine granular boric acid has been most commonly used, and the rates of application have been one-half pound per mature apple tree when placed 35 feet apart, or 30 pounds per acre. The material may be applied at any time during the year, but it takes at least a month before it becomes effective. For example, spring application did not prevent drought spot in the current season's crop, and late fall applications did not prevent die back the following spring.

Results. The extensive use of boron applications to orchard soils where these disorders were severe makes available reliable results as to the efficacy of the treatment. The method was recommended in 1936, and in that year it is estimated that 7,000 acres were treated, and in 1937 an additional 7,000 acres. This single treatment has effectively prevented a recurrence of disease, and

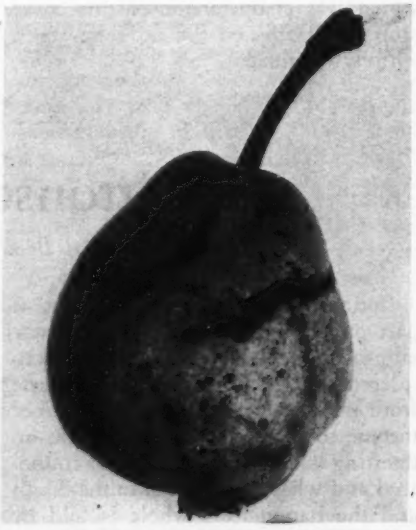


Fig. 9.—Drought spot on pear.

Fig. 10.—Die back on pear.

the trees have returned to normal health and vigor.

The specific effect on crop increase is difficult to determine, owing to the influence of many factors that vary from year to year, but in apple the average annual production for the 3 years subsequent to treatment has been approximately 1,000,000 boxes higher than for the 3 years immediately previous. No toxic effects whatever have been noted on any tree, and no material injury has occurred on any of the cover crops used. The yellow condition of alfalfa foliage, which was characteristic of this cover crop in all affected orchards, has been entirely eliminated.

Future Treatments. The question as to how long a single treatment will be effective can be determined only by experiment. In British Columbia, experimental soil applications were first made in 1935, and a limited number of trees were treated at the one-half pound per tree rate. These, though severely diseased when the treatments were made, have now produced four healthy crops. Other experimental applications were made in 1936, and 1,000 trees so treated have produced three healthy crops, except for one limb of one tree where some drought spot and corky core were found in the 1939 crop. In observations made in orchards treated by growers in 1936, a few diseased apples were found in the 1939 crop. The 1939 chemical analyses of tree tissues regularly indicated an ample supply of boron in the 1936 treated trees, though in exceptional cases the content was dangerously low. Soil analyses have indicated in all cases a higher content than that of untreated native soils of the district. On the basis of these experiments and observations, it is concluded that a small amount of disease might be expected in the 1940 crop on trees treated in 1936. To prevent this possibility, growers have been advised that these trees should now receive a second application.

Cottonseed Meal

(A Book Review)

Cottonseed has become an important part of the large agricultural industry of growing cotton. At one time considered a troublesome and bulky waste from the ginnery, it is now a source of income to the cotton grower. The interesting and significant story of cottonseed and what it can mean to the South and the nation as a whole is told by Robert S. Curtis in his book, "Cottonseed Meal," (The Robert S. Curtis Publishing Company, Raleigh, N. C., 1938. $5.00).

As the name of the book implies, principal attention is given to the meal, but all factors concerned with cottonseed are included as background. The history of the development of the use of cottonseed first as a fertilizer and more recently as a feed, is traced. When

the demand for cottonseed oil resulted in the meal as a by-product, the easiest thing to do with the meal was put it back on the land as a fertilizer. As a plant-food carrier, principally of nitrogen, it enjoys a high repute and gives good results. However, the meal is much more valuable as food for livestock.

There has been some prejudice against cottonseed meal as a feed due to bad effects on animals when fed in large quantities. At first this was thought to be due to harmful substances contained in the meal. Experimental work has shown, however, that the difficulty is really due to an unbalanced ration not supplying vitamines and proper nutrients when the animals do not have a sufficient variety in the diet. One-sided feeding with other concentrates will produce similar results. The author shows that when properly supplemented with other feeds, cottonseed meal is a very good concentrate. A large portion of the book is devoted to this phase of the subject.

The increased production of livestock is being stressed in programs to build a sounder and more prosperous agriculture in the South. Professor Curtis shows how, by properly feeding livestock with cottonseed meal and other feeds produced on the farm, carefully conserving the manure, and applying it to the land, the farmer would have a broader source of income and maintain the fertility of this soil. The great amount of practical information on the most efficient use of cottonseed meal and the completeness with which the author has gone into the subject make this book of value to practical farmers, students and research workers.

Tobacco Production Benefits by Research

(*From page* 13)

75 per cent effective, and the fumigation method, termed 100 per cent effective. In fumigation for control, Benzol and Paradichlorobenzene (PDB) are employed.

The program of the test farm has not only been to search for control methods to combat diseases, pests, and to find disease-resistant varieties of tobacco, but includes research to determine the best cultural methods, better methods of applying fertilizers, crop rotations, varieties, and better curing methods.

Numerous experiments are being conducted to determine the most economical application of fertilizer. Findings in three of the more important projects, listed in the biennial research report of the farm, are as follows:

Sources of Nitrogen for Tobacco—A number of sources of nitrogen have been used in crop tests, and efforts have been made to measure the relative differences. Soybean meal has been one of the few organic sources which have shown up reasonably well. If and when this product can be bought cheaply enough to be used as a fertilizer, the indications are it will be very satisfactory. While there may not be such marked differences between sources of nitrogen, at the same time it certainly seems worth while to use more than one source of nitrogen for compiling or mixing a tobacco fertilizer.

Sources and Amounts of Potash—Several sources of potash have been used during the past few years in experimental work, and recently the rate has been more widely varied than heretofore through a series of plats where from 30 to 300 pounds of K_2O per acre were applied. The results very definitely indicate that considerably more potash, than has been applied in the past, could be used. Both yield and quality have been progressively improved up to around 250 pounds of K_2O

per acre, with the indication that the curve of improvement would straighten out above that point. Apparently there is not so much difference between the sources of potash, provided that too much chlorine is not available. On some soils more than 20 pounds of chlorine per acre appeared to injure both quality and yield, while on stiffer soils 30 pounds could be used with safety. There are some indications that where high potash is used, the sulphur trioxide (SO_3) may be increased.

Fertilizer Tests With Calcium, Magnesium, Sulphur, and Chlorine—Small amounts of magnesia (20 to 30 pounds per acre) appear to benefit both yield and quality on the majority of soils, even on new land which has just been cleared. Little can be said at present as to the proper amount of sulphur that is necessary for the best result. There are indications that very heavy amounts of SO_3 have a tendency to darken the color of the cured leaf. The point of change has not been definitely determined. In regard to chlorine, apparently there is no question that large amounts of chlorine injure the growth and influence unfavorably the burning quality of the cured leaf. On the other hand, small amounts of chlorine, 20 to 30 pounds per acre, seem to give slightly better texture and larger yields.

At present, tobacco-curing experiments are being conducted at the farm using wood, coal, oil, and electricity in an effort to determine the economic value of each fuel as well as the curing qualities of the fuel.

The modest and dominating figure behind the tobacco research scene and the successful experimentations at the test farm is E. G. Moss, who has devoted 28 years of his life to bettering the lot of the tobacco grower. He has been assistant director in charge of the Tobacco Station since it was founded in 1912 and also holds the position of senior agronomist of the U. S. Department of Agriculture. His knowledge of tobacco diseases and problems is not only known and appreciated by virtually every North Carolina leaf producer, but has brought him international recognition.

Moss assisted in the establishment of the test farm which was purchased by the North Carolina Department of Agriculture when the late R. W. Scott, father of Commissioner of Agriculture W. Kerr Scott, was chairman of the State Board of Agriculture's test farm committee. Other prominent research-minded individuals "fathering" the creation of the tobacco station were Dr. B. W. Kilgore, then director of the North Carolina Experiment Station and now State chemist; W. E. Hern of the U. S. Department of Agriculture, Bureau of Soils; the late Major W. A. Graham, then commissioner of Agriculture, the late John Webb and R. W. Lassiter of Oxford. At the time of its founding, the station was the only one in the United States devoted exclusively to tobacco work.

A Cooperative Program

From the beginning, the North Carolina Department of Agriculture and the U. S. Department of Agriculture have conducted the tobacco research cooperatively, and in later years the North Carolina Experiment Station joined in the program.

From a modestly equipped tobacco research center, the Oxford farm has enjoyed steady growth and increasing prestige, and this summer a new 37-room office and laboratory building and greenhouses, constructed with an $80,000 Federal appropriation, were dedicated. The buildings will be used by workers in the Bureaus of Plant Industry and Entomology and Plant Quarantine and also by Assistant Director Moss and specialists in the State work. Incidentally, the completion of the new structure will give research men approximately five times more space for tobacco-insect and disease-control laboratory projects.

Ladino Clover "Sells" Itself

(*From page* 16)

dled more easily as grazing than for mowing. Usually by the fourth season grasses come in to form a mixed stand, and Ladino may go out and be replaced by grasses or natural pasture clover depending on fertility and other conditions. A field on the Sturtevant farm, Halifax, has survived 8 years, and the Ladino is still productive. This stand each year has been first cut for hay and then pastured to furnish valuable mid-season grazing.

In order to produce its heavy yield, liberal feeding of the crop is important. If adequate manure, lime, and superphosphate have been added in fitting the soil to establish well the initial clover seeding, then annual feeding of the subsequent Ladino stand may be accomplished by top-dressing. This is possible largely because of the surface feeding habit of its runners.

A treatment found desirable for Ladino in this State is a mixture of about 250 pounds each of muriate of potash and of 20 per cent superphosphate (or its equivalent) to the acre. This is applied annually as top-dressing. This treatment has been followed on the Sturtevant field in addition to a light dressing of manure.

Field tests of varying amounts of phosphorus and potash applied as top-dressing for Ladino indicate a response especially to high amounts of potash on Massachusetts soils. In these tests the response in most cases was decidedly greater from potash than from superphosphate, but the response was slightly best from applying both these items. A 300-pound rate of muriate of potash (60 per cent) seemed optimum for annual application, whereas a 150-pound rate failed to show as marked response. The addition of superphosphate (20 per cent) at 200- to 300-pound rates was beneficial if applied along with potash.

Ladino has not proved of value as a clover for permanent pasture sods. In this respect undoubtedly the smaller strains seem superior largely because of their ability to survive under close grazing practice. The chief value gained from Ladino comes in the early stages of a seeding, and for this reason the seed is included in mixtures seeded primarily for grazing use. As a grazing crop for intensive management and feeding of dairy cows to save on grain, it seems to have no equal in this region.

As the Ladino plants disappear, a native turf volunteers to take its place, the nature of which is largely characteristic of the particular soil and of the fertility supplied. Because of the liberal mineral fertilization recommended for the Ladino crop, ideal conditions in this respect have been provided for a natural clover and blue grass sod to develop. Moreover, it seems fair to state that this latter sod results from no direct expense to it, since the treatment costs may be amply repaid by the Ladino crops which precede.

While top-dressing is a method of improving pasture sods which may apply in many cases, yet seeding Ladino is another means of increasing the supply of pasture feed. To plow (or bog disk) successive areas which can be worked to supply intensive grazing from Ladino for the milking herd, with a resultant sod suitable for young stock and dry cows, is one method of producing pasture feed which interests dairymen in Massachusetts.

"Hello. Is this the beauty shop?"
"Yes, sir."
"Send one over, will you?"

"Why do you call your boy friend 'Pilgrim'?"
"Because every time he calls he makes a little progress."

Potash Helps Cotton

(*From page 7*)

usually resulted from the use of 8 per cent potash in the fertilizer.

Use of potash fertilizer on the wilt-susceptible Coker 100 and Half and Half varieties of cotton resulted in decreases of 9 to 20 per cent in the numbers of wilted plants (Table 1). Only relatively few plants wilted in the 7 wilt-resistant varieties of cotton, so only small differences in percentages of wilted plants could be expected from the use of potash fertilizer. However, use of potash fertilizer resulted in a decrease of wilted plants in 6 of the 7 varieties.

Fig. 3.—Central two rows show severe symptoms of potash deficiency associated with Fusarium wilt in 52% of the Coker 100 and Half and Half cotton treated with 6-8-0 fertilizer. In contrast to these center rows, nearly normal Toole (Perry) in the row on the left and Miller 610 cotton in the row on the right resulted from treatment with 6-8-4 fertilizer.

Decreases in percentages of wilted plants are

TABLE 1.—COTTON YIELD INCREASED AND WILT DECREASED BY POTASH; AVERAGE OF 1937, 1938, 1939

Variety	6-8-0			6-8-4			6-8-8		
	Per cent of plants		Yield per acre*	Per cent of plants		Yield per acre*	Per cent of plants		Yield per acre*
	Wilted	Showing potash deficiency		Wilted	Showing potash deficiency		Wilted	Showing potash deficiency	
Coker 100**	17.7	43	534	10.8	15	722	8.2	4	871
Half and Half**	33.2	40	482	23.3	15	684	13.1	8	731
Clevewilt 6	0.6	26	685	1.1	13	861	1.3	3	912
Cook 144–68	1.2	42	619	1.7	15	816	0.8	4	937
Cook 307 (Rhyne)	1.4	29	686	1.4	6	888	0.6	3	876
Dixie Triumph 25–12	1.8	37	708	0.7	24	848	1.1	6	932
Dixie 14–5–2	3.7	33	668	1.6	12	833	1.8	3	922
Dixie Triumph 85	1.9	36	672	1.3	13	845	0.7	3	895
Miller 610	3.3	32	670	1.6	11	928	1.6	2	955

* Yields are recorded as pounds of seed cotton per acre.

** Wilt-susceptible varieties; other 7 varieties are wilt-resistant.

explained on the basis that Fusarium vasinfectum, the fungus that causes cotton wilt, is a facultative parasite that damages weak plants more than it damages strong plants. Thus, it usually caused its maximum damage in the plants starving from lack of potash, but was less destructive in the plants with adequate potash.

The experiments and observations on commercial fields showed that potash greatly reduced the severity of wilt and rust on cotton. On the average, the use of 24 lb. of potash per acre increased the yield of susceptible varieties 38 per cent and of the resistant varieties 28 per cent. Where 48 lb. of potash per acre were used, the yield of susceptible varieties was increased 58 per cent and the yield of resistant varieties, 37 per cent.

Fortunately, Fusarium wilt is not yet very destructive in most fields in east Texas, but there is no apparent reason why it should not continue to become increasingly destructive. If farmers will practice crop rotation soon, use wilt-resistant varieties of cotton, and apply adequate amounts of potash fertilizer, they can greatly increase their yields of cotton, and also delay for many years the time when Fusarium wilt will seriously decrease the yields of cotton in most of their fields.

How Shall We Fertilize Vegetable Crops?

(*From page* 22)

more, why should we apply so much quickly available plant food when we use chemicals? We never did it with manure, and we haven't gotten any better yields than we did with manure.

Row applications of any kind are conducive to poor distribution of plant food over a period of years. If the fertilizer was all used by the crop it would not matter, but we build a residue which is going to make good and poor spots in the field. Row application of fertilizer certainly does not lend itself to uniform growth in a rotation where heavy applications are made only once in 3 or 4 years. It reminds me of an alfalfa field I saw last spring in which the growth was good in regular 20-inch bands across the field interspersed with 2-foot bands on which very little alfalfa had started. Two years before, this field had been in melons for which the fertilizer had been placed under the row.

What seems to be even a greater objection to this surface application of fertilizer is the lack of penetration of phosphoric acid and lime. The phosphoric acid ties up in the soil before the surface soil is again turned under, and the lime has been neutralized and is no longer capable of correcting acidity when it is turned under. As a result our subsoils become poor media for root growth. Good crops can only be grown with healthy, vigorous roots. Now we find after years of applying fertilizer on the surface, that we have to use costly methods of subsoil conditioning to make our soils productive.

Need for Lime

Unfortunately less than 25 per cent of the farms in New Jersey have sufficient lime to grow good yields of vegetable crops. This probably is also true for the coastal plains States and other regions having humid climates. Phosphoric acid only becomes sufficiently mobile and thereby available to plants if there is sufficient lime in the soil to prevent aluminum and iron from coming into solution. As a result of continuous fertilization with chemical fertilizers carrying appreciable quantities of phosphoric acid and insufficient lime, there has been built up or accumulated an appreciable quantity of phosphoric

acid for future use. This however is largely in the surface soil. The addition of lime to such a soil will gradually release this stored phosphoric acid for plant growth.

A series of plots were established on a strongly acid soil to determine the value of different amounts of phosphoric acid on the tomato. The field was limed and plots were established which received 0, 4, 8, 12 on up to 20 per cent in a 5-0-10 mixture at the rate of 1,500 pounds per acre. The second year all the plots produced approximately 16 tons of tomatoes. The third year the plot receiving 5-0-10 produced almost as many tomatoes as did the highest yielding plot which received a 5-12-10 mixture. The third year there was a slight increase in yield up to 8% phosphoric acid.

Lime was put on each year, and the pH during the 3 years was increased from 5.4 to 6.7 on a sassafras loam soil. However, the fertility of these plots changed and phosphoric acid deficiency began to show in the plants on the plots which had not received any in the fertilizer. Things like this may lead us into erroneous conclusions as to the nutrient needs of the tomato. The quick soil tests showed no appreciable amount of phosphoric acid at any time on these plots, and yet we know that a 16-ton crop of tomatoes requires considerable phosphoric acid. It is a good story on the need for lime.

Had a subsoil liming experiment been established on this ground, the value of adding lime to the subsoil would have been demonstrated. Had this field been properly limed from the start, perhaps no method of fertilization would have shown any particular advantage. However, we have seen the initiation of a new practice, fertilizing the subsoil, which is bound to give results on many farms, because we neglected that subsoil in the past by placing all our fertilizer on top of the ground and neglected to use enough lime to keep the pH at 5.5 or above. Fertilizing the subsoil of course is a temporary procedure which we can eliminate by either plowing under lime and fertilizer or keeping our soils sufficiently well limed to make phosphoric acid more mobile in the soil.

Best Methods of Application

One is tempted to ask, "What is wrong with our research program?" Why have we gone off on a tangent and evolved various makeshift methods for growing vegetable crops, particularly where we can use sufficient liming materials? There is some justification for those crops which must be grown on acid soils because of disease. There we have to use special methods to make phosphoric acid available in spite of the presence of materials which are ready and waiting to tie it up.

There seem to be a number of ideas as to the best method of applying fertilizer, and we must come to some common understanding if we are going to make progress.

We have several fundamental things to settle before we can start to talk about methods of applying fertilizer. First of all, most crops have a lime requirement and aluminum tolerance that determine what the condition of the soil must be regarding acidity. This is probably one reason why we have not been successful in duplicating yields from manure plots with chemicals. There are wide differences in soil types, and methods of applying fertilizers should vary with these types.

In a survey of 135 tomato farms in New Jersey in 1939 the majority applied their fertilizer under the plants or side-dressed. Only two plowed under fertilizer.

Results from experiments with liming materials very definitely show that most crops will grow better with some lime, while others actually require an abundance of liming material. If that is the case, our methods for those crops should be worked out on soils that have sufficient lime to satisfy the crop. There

seems to be little justification for working out a method on acid soil for a given crop, when the real need of the crop is lime.

Investigations have revealed certain advantages for different methods of applying fertilizers, and each probably has its place in the vegetable industry.

Broadcasting fertilizer. This method consists of applying all the fertilizer on the surface after plowing and mixing it with the soil as the field is prepared for the crop. It is used for all shallow-rooted crops which are not cultivated, or for narrow-rowed crops that are cultivated with light tools. Very good results have been obtained with this method, particularly where some lime is added to the soil. The fertilizer is distributed sufficiently so that root injury does not occur. On acid soils the phosphorus will of course tie up rather quickly. However, crops grown in this manner should be grown on limed soils. The low yields would prohibit the use of acid soils. It is being used for wide-rowed crops on dairy farms with exceptionally good results.

The main disadvantage is leaching of the nitrogen and potash on light sandy soils during a heavy rain before the crop has made sufficient root growth to meet between the rows. However, this leaching probably has been overemphasized. If the roots do not meet between the rows 3 weeks after the plants are set, the soil is probably in too poor condition to support good root action. Such plants would not be benefited by fertilizer. I saw a tomato field last summer in which the plants were just large enough to be covered by a bushel basket. The roots had not gone more than a foot from the plants, and none of the roots were very active. The plants looked badly chlorotic, were making very little growth, but had set 10 to 20 fruits. They had been given a liberal supply of fertilizer. When limestone was worked into the soil around the roots, they started to grow, and the chlorotic condition disappeared.

Broadcasting the fertilizer probably is not the best method. In the experiments where it was compared with plowing under the fertilizer at New Brunswick, it has not produced as good results. There may be certain cases where broadcasting will produce better results, but over a period of years plowing under should give better results.

Plowing under fertilizer. Plowing under the fertilizer places some in the bottom of the furrow, while some is distributed over the back of the previously turned furrow. For vigorously rooted plants this seems ideal. It is far enough from the roots to prevent injury when the plants are young, and what seems even more important, at no time does the plant obtain an excessive amount of plant food with which to make an abnormal growth. Most crops grown in rows are planted deep enough so that the fertilizer at the bottom of the furrow is actually only a few inches from the roots at the time plants are set, or if seed is planted, the young seedlings will make contact within a short time.

It distributes phosphoric acid more uniformly and places the fertilizer where more soil moisture makes it available to the plant. The subsoil does not become deficient in phosphorus or lime where fertilizer and lime are plowed under. As a result crops grow more uniformly, somewhat comparable to growth from manure.

Applying fertilizer in bands. This method has some advantages and is particularly adapted for acid soils. It has given particularly good results on potato farms, where the soils must be strongly acid to prevent scab. A potato variety that could be grown on neutral soils would be a boon to vegetable growers who wish to grow potatoes in rotation with other vegetable crops. The same may be said of the sweet potato, but because this crop remains on the ground all season and is grown on the lighter soils, other methods of fertilization may be used.

By placing the fertilizer in 2-inch bands, 3 inches from the plant or seed and at the same level, it is possible for the roots to get ample phosphoric acid before it is fixed in the soil. Lime applied later will release this phosphoric acid. Phosphoric acid must be available more or less continuously throughout the life of the plant.

Where other crops must be grown in rotation with potatoes, the band method may be necessary to secure the most out of the soil. The method is not suitable where fertilizer is applied only 1 year in 4, because the phosphoric acid is not distributed between the rows to accommodate the crops that are grown broadcast. It may be more economical to apply the fertilizer in bands, because the grower can use less.

The split application method. Perhaps there is no better method of applying fertilizer than to apply it to the crop when it needs it, in such a manner that it can absorb it, and in such amounts that the fertilizer will not injure the roots. However, few growers will do this, regardless of how good their intentions may be. It requires several applications at timely intervals, and very often the grower does not get the application on until it is too late. There are many modifications of this method. They all mean a greater expenditure of labor for the grower, but may save him some money on fertilizer. The methods have application on the lighter and acid soils and make it possible to grow good crops on these soils but at much greater expense.

On the loamy sands or the very light sandy loam soils, 200 or 300 pounds of fertilizer may be applied under the row, and further applications would then have to be made between the rows as the crop needed it. Or the fertilizer could be used in solution, part applied when the plants are set or the seed is sown, and additional fertilizer applied in water between the rows at semimonthly intervals. This method has given particularly good results.

There are several methods that may be mentioned: broadcasting, plowing under, or applying the phosphoric acid under the row and applying the nitrogen and potash as side-dressings at frequent intervals as needed; applying two-thirds of the fertilizer as above but applying mixed fertilizer as side-dressings; applying a third of the fertilizer under the row and the remainder as side-dressings; or broadcasting two-thirds before or after plowing and placing the remainder under the row. These methods are applicable to acid soils, but are more costly than to correct the acidity with lime and plow under the fertilizer.

The row method. This method consists of applying all the fertilizer under the row. The fertilizer is applied on the surface and worked into the soil with a cultivator or other suitable implement. This is a good practice in years of scanty rainfall and on acid soils, but may be too much of a good thing in years of good rainfall. If the grower can use this method without killing his plants, he may get very good results. It does not give good results every year. It has few real advantages and yet is used extensively by growers, because they can get fairly good results on acid soils. Furthermore they do not spend much time putting the fertilizer on.

Starter solution. This should be mentioned, because it can be used with any method except where large quantities of fertilizer are used in the row. It consists of applying fertilizer dissolved in water around the plants as they are set, or it may be applied in the furrow with the seed. On acid soils this adjunct to other methods has given particularly good results. On well-limed soils that have received ample fertilizer in the past, there may be no advantage in using it. It has a particular use where fertilizer is plowed under.

Subsoil fertilization. Fertilization accompanies plowing of the subsoil, or lime and superphosphate are merely applied in the bottom of the furrow. This is a temporary practice that is necessary on some farms because of the too long-continued use of row, band, or surface fertilization without lime. It probably would not be necessary where fertilizer and lime have been plowed down in the past, nor where sufficient lime has been used to keep the phosphoric acid mobile. However, where it was needed, it has given phenomenal growth. Asparagus plants have made three times as much growth by this method over what was considered good growth by accepted cultural methods.

A combination of plowing under lime and fertilizer with the starter solution will probably give the best results at the least expense and will build up a permanent fertility in the soil that will eliminate the major cultural problems of the vegetable grower. Acid soils require special attention. Light sandy soils may require special attention. Where only a few pounds of fertilizer are used, row methods may be better.

MSS. in D. C.

(*From page* 5)

duced our masterpieces in rooms 306 to 309, and I hope we made those corridors historic, what with the dashing and clashing and "okeying" we performed therein. At one end of our promenade was a big, smoky room where the professional leggers and trained seals of the daily press took what copy we hung on their hooks—and anything else they happened to suspect was lurking behind the suave language of our official releases. In fact as it was, there were two rival news gathering staffs there most of the time—the official one of which we were the main spokes, and the professionals who often broke through our lines to tackle some innocent AAA chieftain slightly off guard. At no time did the professionals honestly think we were trying to smooch them, but some of the scribes with opposition papers had standing orders to trip us up when they could.

Finally the incoming army of attachés to the AAA got so large that the new "extensible" building one street to the rear had to be partitioned off to accommodate part of the crew. This huge structure is an amazing maze of halls and rooms that look alike. Taking a couple of hand-out paragraphs out for a walk to acquire certified blessings from experts, economists, lawyers, consumer's counsel misanthropes, and bigwig administrators was a meandering marathon, believe me. Yet some folks accuse Federal employees of indolence and haste. I seldom had brain-fag, but how about those burning bunions?

You won't find any of our obscure names recorded on the roster of veterans who alternately triumphed and trembled during the trial-and-error phase of the original AAA. But do not forget that government agencies are dependent upon public opinion, and this in turn rests on the knowledge and tact of the information staff who contact newspapers, magazines, and radio, or who fix up speeches for busy moguls to deliver.

WE had to be in on all policy meetings and dress rehearsals or else run the chance of misunderstanding and indiscreetly misinterpreting the AAA program, involved as it was (and is) with devious details. For not all our

press contacts were via the hand-out system. At least half of the information we issued resulted from personal interviews and side comments to those pestering newshawks on our flanks. They seldom accepted releases at full value. We commodity authorities were always sought and badgered hard for more light on uncertain points. This meant quick thinking and plenty of diplomacy, as well as a thorough working knowledge of the special fields we covered. In other words, we "ran interference" for Wallace, Peek, or Davis, and each division leader, while they carried the pigskin to a tackle-flop or a touchdown.

Yes, we were a bunch of live-wire "ghosts." We haunted those ornate offices early and late, being particularly apt to gibber and grimace at speech-making by proxy. This is the last word in a ghost writer's seance, the occasion when you renounce all fleshly ambition and put your spirit into the body of some other guy whose only job is to rise on his haunches and read a talk that you wrote after long library labor. After doing a few of these orations in a week when our Brain Battery was slated to appear at some public institute, the fagged and sweaty ghosts sought the cooling forgetfulness of the famous Potomac night boats—to Marshall Hall Park and back for seventy-five cents, with jitterbugs, ginger-beer, and goofiness. And on week-ends some of the most exhausted who didn't know any better went for heat relief clear to Norfolk!

TWO other diversions of a week-end were common to us relaxing reporters. We had a choice of doing the battlefields or seeing the national zoo again. I recall taking a trip on a much-advertised "cheap" bus system down through Charlottesville, Culpeper, Gordonsville, and Orange; and another jerky jaunt out from Fredericksburg toward Chancellorsville, and standing bareheaded beside the Stonewall Jackson monument. Bumps and contusions and a blazing motor were experiences on that trip for economy's sake which induced me to do the next one afoot. This entailed a hike from Centerville to Warrenton including half an hour spent rebattling Bull Run with a loquacious peg-leg caretaker in the shadow of the Henry House.

We preferred the national zoo out on the western limits of the park to the other national zoo under the big dome. In the animal circus we fed the elephants pounds of AAA-protected peanuts, laughed with the hyenas over the vagaries of statecraft, and repeatedly urged that funny talking bird to voice the perennial problem of Washington life—"How about the appropriation?"

BUT before closing I insist on exploding a notion that on account of the climate it is a personal sacrifice for "your elected representative" to reside in Washington. The country has been plastered with this so long and continually that folks think the District of Columbia is a suburb of Hades. But let anybody who wants to disillusion himself spend a year there and then pike west to the Mississippi Valley and beyond during one of our average July dry spells! Remember this and do not vote for anybody who intimates he is a hero to leave his Midwest haven for a season's workout in Washington. Take him at his word and keep him at home!

But Art of Iowa and I weren't sent there to suffer through the suffrage of the ballot box. We were volunteers who went on our own accord looking for an oasis during an extreme drought on the "Great American Desert." As soon as the government got a firm hold on the farm problem, then the farmers back home threatened to quit "growing nothing" unless we returned. Hearing no objection from the White House and mindful of the crying need to balance the budget, we removed ourselves from the payroll.

That was the first real blow the AAA received. The next one came from the Supreme Court!

Mark Him Off

"That was too bad about old Gotrock's check bouncing back, Mamie," said the blonde to her auburn-haired girl friend. "Yeh," answered Mamie, "and it was marked 'Insufficient Fun.'"

First little negro boy (amazed when his companion admitted he didn't know whether he was 4 or 5 years old): "You mean you don't know how old you is?"

Second boy: "I don't know."

First boy: "Has you ever thought about women?"

Second boy: "No."

First boy: "Then you is 4, cause I is 5."

Customer: "Heavens, man! Do you want to burn me. That towel is scalding hot!"

Barber: "Beg your pardon, sir. I couldn't hold it any longer!"

Regrettable Mistake

It was during Prohibition. The railroad station was packed with a gay going-away throng. Over at one side of the waiting room, stood a quiet little man, fidgeting about and attempting to hide himself from the crowd. A Federal Agent noticed that the stranger had something in his coat pocket from which drops were falling in slow trickles. The Fed, with a gleam in his eye, collared the gent, put a finger out under the drops, caught one and tasted it. Then he spoke to the man.

"Scotch?"

"Nope," replied the stranger, "Airedale pup!"

A colored preacher was hearing confession. In the middle of it, he stopped the young sinner, saying, "Young man, you ain't confessin'—you's braggin."

Sweet Young Thing: "Please, could you tell me where I could get some silk covering for my settee?"

Floorwalker: "Two aisles down and one over for the lingerie department."

Made No Difference

Here lies the body of William Jay
Who died maintaining his right of way;
He was right, dead right, as he sped along.
But he's just as dead as if he'd been wrong.

"Sorry to hear your engagement is broken off, old man."

"I'll get over it. But the worst blow was when she returned my ring marked 'Glass—Handle with Care.'"

A little boy went to a very nice shop on the Avenue to try on a new suit, being taken by his sister, a regal lady, graduate of Vassar. The youngster giggled and squirmed as the tailor, a young, brisk, well-dressed fellow, nimbly made the marks on his suit with chalk. Having entered fully into what he thought was the spirit of the occasion, the boy suddenly looked up and said to the tailor, in a confidential tone: "If you want to tickle my sister, try her stummick."

FERTILIZER *Films* AVAILABLE

WE ARE NOW PREPARED TO LOAN without charge to agricultural colleges and experiment stations, county agricultural agents, vocational teachers, responsible farm organizations and members of the fertilizer trade, several films bearing on the proper use of fertilizers, particularly potash. *Distribution is being made from our respective branch offices as noted in the listing below, and anyone interested in showing these films should direct their requests to these offices.*

Potash in Southern Agriculture

Covers fertilization and potash deficiency symptoms of cotton, tobacco, and corn in the various States of the South. Depicts experimental work now in progress at several Experiment Stations, also crops in the field, fertilizer placement work, and scenes in a fertilizer factory.

16 mm.—sound, color—running time 20 min.

Projectors will be loaned where necessary.

Write to—American Potash Institute, Inc., Mortgage Guarantee Building, Atlanta, Georgia.

Potash From Soil to Plant

Covers testing soils to determine fertilizer needs, sampling of soils, potash deficiencies on prunes and grapes, also effects of fertilization on Ladino clover.

16 mm.—silent, color—running time 40 min. (on 1600 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

Bringing Citrus Quality to Market

Shows influence of fertilizers, particularly potash, on yield and quality of citrus fruit. Quality factors include thickness of rind, volume of juice, weight and general appearance of fruit.

16 mm.—silent, color—running time 25 min. (on 800 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

Machine Placement of Fertilizer

Covers methods of applying fertilizer to California orchards, lettuce, and sugar beets. Shows scenes of various types of apparatus devised by growers for applying fertilizer in orchards and on row crops.

16 mm.—silent, color—running time 15 min. (on 400 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

New Soils For Old

This film was prepared for the Department of Agronomy, University of Illinois. Deals with the experimental work on Illinois Soil Experiment Fields and stresses the benefits from a balanced soil fertility program using limestone, phosphates, and potash in growing corn, wheat, clover, and other crops.

16 mm.—silent, color—running time 40 min.

Write to—American Potash Institute, Inc., Life Building, Lafayette, Indiana.

Fertilizers Improve Midwest Crops

Shows effects of proper fertilization on the growth of corn, wheat, alfalfa, and other crops in Illinois, Indiana, and Iowa. Includes potash, phosphorus, and nitrogen starvation symptoms and their confirmation by chemical tissue tests.

16 mm.—silent, color—running time 40 min.

Write to—American Potash Institute, Inc., Life Building, Lafayette, Indiana.

Requests for these films should include information as to group before which they are to be shown, date of exhibition, and period of time of loan.

AMERICAN POTASH INSTITUTE, INC.

Investment Building **Washington, D. C.**